EFFECTS OF COW AND CHICKEN MANURE SUPPLEMENTATION RATIOS ON THE YIELD OF GREY OYSTER MUSHROOM (*PLEUROTUS PULMONARIUS*) CULTIVATED ON RUBBER SAWDUST SUBSTRATE

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ABSTRACT:

Grey oyster mushroom (*Pleurotus pulmonarius*) is a widely consumed edible fungus distinguished by its gray coloration, soft texture, funnel-shaped cap, and mildly sweet, chewy flavor. It is a valuable source of protein, vitamins (notably B-complex and D), and essential minerals, and has been associated with enhanced immune function, cholesterol reduction, and cardiovascular protection. In Vietnam, this species is commonly cultivated using rubber sawdust as a substrate. This study investigated the cultivation of *P. pulmonarius* on rubber sawdust supplemented with cow and chicken manure at varying ratios (0%, 2.5%, 5%, 7.5%, and 10%). The study aimed to evaluate fresh fruiting body weight and biological efficiency (BE, %) and to identify the optimal manure supplementation ratio for maximizing yield in 500 g substrate bags.

Keywords: *Pleurotus pulmonarius*, rubberwood sawdust, B.E. (%), mushroom cultivation.

1. Introduction

The genus *Pleurotus* contain edible mushrooms belonging to Class Basidiomycetes and Order Agaricales. Mushrooms are widely distributed in the temperate and tropical regions (Chang and Miles, 2004) [1]. *P. pulmonarius* is widely marketable and sells well in southeast Asia, Japan, and several other countries [2]. Mushroom cultivation is a useful method of environmental waste management and waste disposal [3]. Among higher fungi, pleurotus is well acknowledged as an economically important genus. This may be attributed to its world – wide dispersal, its broad adaptability in growing under various conditions and of course to its dietetic properties. Thus, *Pleurotus* mushrooms are now cultivated on many agricultural wastes and industrial by - products providing nutritious foods (zervakis and Balis (1991) [4]. *P. pulmonarius* is known to be rich in multiple bioactive components [5]. In this study, *Pleurotus pulmonarius* was cultivated on rubberwood sawdust substrate supplemented with cow manure and chicken manure at different ratios

(0%, 2,5%, 5%, 7,5%, and 10%) to evaluate the fresh fruiting body weight and biological efficiency (B.E, %) of *Pleurotus pulmonarius.*

2. Materials and methods

Rubberwood sawdust, an agricultural by-product, was selected as the substrate for cultivating *Pleurotus pulmonarius.* Cow manure and chicken manure were supplemented at different ratios (0%, 2,5%, 5%, 7,5%, and 10%) into the rubberwood sawdust for mushroom cultivation.

The rubberwood sawdust was first treated and sieved to remove impurities, then moistened to a moisture content of 67–70% using 1% lime water. After that, it was composted in piles for 24–48 hours. During the composting process, the pile temperature increased to 60–70°C. The pile was regularly turned to ensure adequate oxygen supply and to reduce anaerobic fermentation. Turning the sawdust layers also helped decompose the substrate and eliminate many harmful microorganisms.

Subsequently, cow manure and chicken manure were added at the specified ratios (0%, 2,5%, 5%, 7,5%, and 10%). The prepared substrate was then packed into nylon bags (500g/bag). The bags were labeled and marked according to the supplementation treatments.

The substrate bags were sterilized at 98°C for 10 hours. After cooling for 24 hours, level-3 spawn of *Pleurotus pulmonarius* was inoculated, and the mycelia were incubated at room temperature.

3. Results and discussion

3.1. Effect of cow manure ratios on the biological yield of Pleurotus pulmonarius cultivated on rubberwood sawdust

Average fresh weight of *Pleurotus pulmonarius* supplemented with different cow manure ratios (Table 1) on rubberwood sawdust substrate

On the 3rd day after inoculation, the mycelium of *Pleurotus pulmonarius* began to adapt to the substrate. By day 14, the mycelium grew rapidly and reached the bottom of the substrate bags. From day 21 to day 55, the mycelium fully colonized the substrate. On day 55, primordia of *Pleurotus pulmonarius* began to appear. By day 56, the primordia developed into fully formed fruiting bodies, ready for harvest.

Parameters observed: fresh fruiting body weight of *Pleurotus pulmonarius* and biological efficiency (B.E, %) of *Pleurotus pulmonarius.*

Average fresh weight (g) of *Pleurotus pulmonarius* supplemented with cow manure on rubberwood sawdust substrate

The results obtained from Table 1, Table 3, and Figure 1 show that the highest average fresh weight of *Pleurotus pulmonarius* was recorded in treatment B3 with 7,5% cow manure supplementation, reaching 57,4 g, which was superior to the other treatments and considered the optimal level. The remaining treatments showed lower values in descending order: treatment B4 reached 44,2 g with

Table 1. Experimental design for evaluating the effect of cow manure ratios on the biological yield of Pleurotus pulmonarius cultivated on rubberwood sawdust substrate

Treatments	DCB	B1	B2	B3	B4
Cow manure (%)	0	2,5	5	7,5	10
Rubber sawdust (%)	100	97,5	95	92,5	90

Source: Author's own work

Table 2. Experimental design for evaluating the effect of chicken manure ratios on the biological yield of Pleurotus pulmonarius cultivated on rubberwood sawdust substrate

Treatments	DCG	G1	G2	G3	G4
Chicken manure (%)	0	2,5	5	7,5	10
Rubber sawdust (%)	100	97,5	95	92,5	90

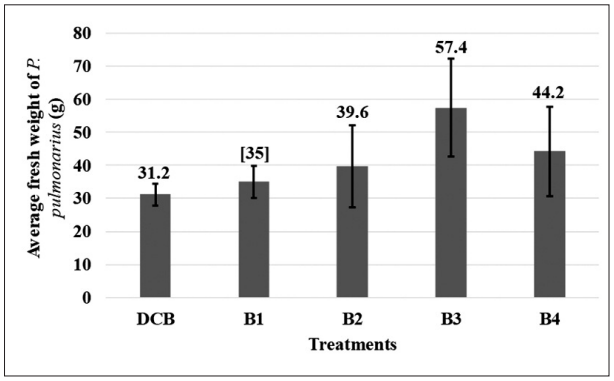
Source: Author's own work

Table 3. Average fresh weight and biological efficiency (B.E, %) of Pleurotus pulmonarius cultivated on rubberwood sawdust substrate supplemented with different cow manure ratios as shown in Table 1

Treatments	Average fresh weight of *P. Pulmonarius* (g)	B.E.%
DCB	$31,2^{a} \pm 3,34$	$17,54^{a} \pm 1,88$
B1	$35,0^{a} \pm 4,85$	$19,66^{a} \pm 2,74$
B2	$39,6^{a} \pm 12,40$	$22,26^{a} \pm 6,97$
B3	$57,4^{b} \pm 14,84$	$32,26^{b} \pm 8,35$
B4	$44,2^{ab} \pm 13,52$	$24,84^{ab} \pm 7,60$

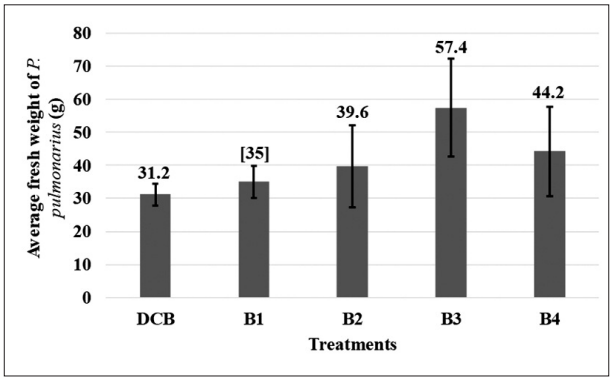
(There is a statistically significant difference, p-value < 0.05).
Source: Author's own work

Figure 1. Average fresh weight of Pleurotus pulmonarius cultivated on rubberwood sawdust substrate supplemented with different cow manure ratios as shown in Table 1



Source: Author's own work

Figure 2. Biological efficiency (B.E, %) of Pleurotus pulmonarius cultivated on rubberwood sawdust substrate supplemented with different cow manure ratios as shown in Table 1



Source: Author's own work

10% cow manure, treatment B2 reached 39,6 g with 5% cow manure, treatment B1 reached 35,0 g with 2,5% cow manure, and the lowest value was observed in the control treatment (DCB), which was 31,2 g without cow manure supplementation.

Thus, the grey oyster mushroom achieved the highest average fresh weight (57,4 g) at 7,5% cow manure supplementation (treatment B3) on rubberwood sawdust substrate.

Biological efficiency (B.E %) of Pleurotus pulmonarius supplemented with cow manure on rubberwood sawdust substrate

The results from Table 1, Table 3, and Figure 2 indicate that the highest biological efficiency of Pleurotus pulmonarius was observed in treatment B3 with 7,5% cow manure supplementation, reaching 32,26%, which was significantly higher than the other treatments and identified as the optimal level. The biological efficiency of the remaining treatments decreased in the following order: treatment B4 reached 24,84% with 10% cow manure, treatment B2 reached 22,26% with 5% cow manure, treatment B1 reached 19,66% with 2,5% cow manure, and the lowest value was recorded in the control treatment (DCB), at 17,54% without cow manure supplementation.

Therefore, *Pleurotus pulmonarius* achieved the highest biological efficiency (32,26%) at 7,5% cow manure supplementation (treatment B3) on rubberwood sawdust substrate.

Figure 3. Primordia and fruiting bodies of Pleurotus pulmonarius under different treatments on rubberwood sawdust substrate supplemented with various cow manure ratios (as shown in Table 1) after 55 days of inoculation

Source: Author's own work

Figure 4. Primordia and fruiting bodies of Pleurotus pulmonarius under different treatments on rubberwood sawdust substrate supplemented with various cow manure ratios (as shown in Table 1) after 56 days of inoculation

Source: Author's own work

3.2. Effect of chicken manure ratios on the biological yield of Pleurotus pulmonarius cultivated on rubberwood sawdust

Average fresh weight of *Pleurotus pulmonarius* when supplemented with chicken manure in rubber sawdust substrate

According to Table 2, Table 4, and Figure 5, the average fresh weight of *Pleurotus pulmonarius* in treatment G1, supplemented with 2,5% chicken manure, reached the highest value of 39,2 g, indicating this as the optimal supplementation level. The subsequent treatments showed a gradual decrease in fresh fruiting body weight as follows: treatment G2 achieved 36,0 g with 5% chicken manure supplementation; treatment G4 reached 29,4 g with 10% supplementation; the control treatment (DCG) recorded 29,0 g without chicken manure addition; and the lowest value was observed in treatment G3 at 25,2 g with 7,5% supplementation.

Thus, *Pleurotus pulmonarius* achieved the highest average fresh weight 39,2 g when supplemented with 2,5% chicken manure in rubber sawdust substrate under treatment G1.

Biological efficiency (B.E. %) of *Pleurotus pulmonarius* when supplemented with chicken manure in rubber sawdust substrate

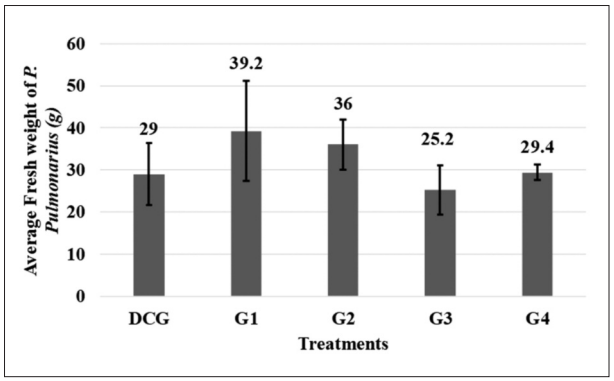
According to Table 2, Table 4, and Figure 6, the biological efficiency of *Pleurotus pulmonarius* in treatment G1, supplemented with 2,5% chicken manure, reached the highest value of 22,02%, indicating this as the optimal supplementation level. The other treatments showed a decreasing trend as

Table 4. Average fresh weight and biological efficiency (B.E, %) of Pleurotus pulmonarius cultivated on rubberwood sawdust substrate supplemented with different chicken manure ratios as shown in Table 2

Treatments	Average fresh weight of P. Pulmonarius (g)	B.E (%)
DCG	$29,0^{ab} \pm 7,35$	$16,30^{ab} \pm 4,14$
G1	$39,2^{c} \pm 11,88$	$22,02^{c} \pm 6,67$
G2	$36,0^{bc} \pm 6,0$	$20,24^{bc} \pm 3,35$
G3	$25,2^{a} \pm 5,85$	$14,16^{a} \pm 3,30$
G4	$29,4^{ab} \pm 1,82$	$16,52^{ab} \pm 1,01$

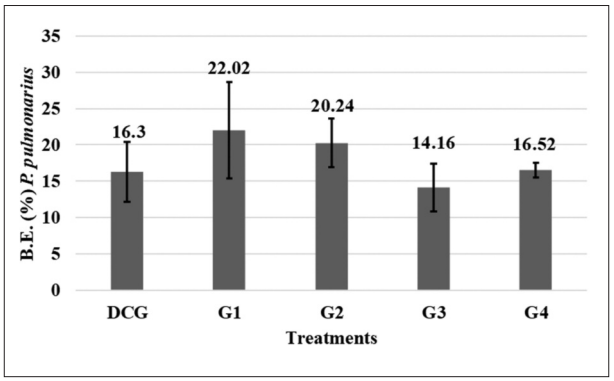
(There is a statistically significant difference, p-value < 0.05)
Source: Author's own work

Figure 5. Average fresh weight of Pleurotus pulmonarius cultivated on rubberwood sawdust substrate supplemented with different chicken manure ratios as shown in Table 2



Source: Author's own work

Figure 6. Biological efficiency (B.E, %) of Pleurotus pulmonarius cultivated on rubberwood sawdust substrate supplemented with different chicken manure ratios as shown in Table 2

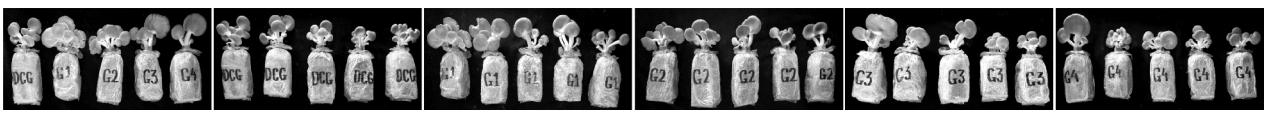


Source: Author's own work

Figure 7. Mycelium and fruiting bodies of Pleurotus pulmonarius under different treatments on rubber sawdust substrate supplemented with varying proportions of chicken manure according to Table 2 after 55 days of inoculation

Source: Author's own work

Figure 8. Mycelium and fruiting bodies of Pleurotus pulmonarius under different treatments on rubber sawdust substrate supplemented with varying proportions of chicken manure (according to Table 1) after 56 days of inoculation



Source: Author's own work

follows: treatment G2 achieved 20,24% with 5% supplementation; treatment G4 reached 16,52% with 10% supplementation; the control treatment (DCG) recorded 16,30% without supplementation; and the lowest biological efficiency was observed in treatment G3 at 14,16% with 7,5% supplementation.

Thus, *Pleurotus pulmonarius* achieved the highest biological efficiency 22,02% when supplemented with 2.5% chicken manure in rubber sawdust substrate under treatment G1 ■

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Received date: February 13, 2026
Reviewed date: February 22, 2026
Accepted date: March 7, 2026

ẢNH HƯỞNG CỦA TỶ LỆ BỔ SUNG PHÂN BÒ VÀ PHÂN GÀ ĐẾN NĂNG SUẤT NẤM BÀO NGƯ XÁM (*PLEUROTUS PULMONARIUS*) TRỒNG TRÊN CƠ CHẤT MÙN CƯA CAO SU

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TÓM TẮT:

Nấm bào ngư xám (*Pleurotus pulmonarius*), là loại nấm ăn phổ biến có màu xám đặc trưng, thân mềm, tai nấm hình phễu, vị ngọt thanh và dai giòn. Nấm giàu protein, vitamin (B, D), khoáng chất, giúp tăng cường miễn dịch, giảm cholesterol và bảo vệ tim mạch, được trồng phổ biến trên cơ chất mùn cưa cao su ở Việt Nam. Nghiên cứu này thử nghiệm việc bổ sung phân bò, phân gà vào cơ chất mùn cưa cao su với tỷ lệ khác nhau từ 0%, 2,5%, 5%, 7,5%, 10% nhằm tính được khối lượng quả thể tươi của Pleurotus pulmonarius và B.E (%), đồng thời tìm ra tỷ lệ phân bò, phân gà bổ sung thích hợp để cho quả thể nấm *Pleurotus pulmonarius* có năng suất cao ở các bịch phôi 500g

Từ khóa: *Pleurotus pulmonarius*, B.E (%), mùn cưa cao su, trồng nấm.