The Mycelium Growth and Weight of Fresh Fruiting Bodies of *Ganoderma lucidum* on the Substrate Peanut Stem – Leaves, Peanut Shell Mixing of Different Ratios (Arachis Hypogaega)

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***Abstract*—Ganoderma lucidum is a rare medicinal mushroom that is very valuable in the prevention and fight against diseases, especially the prevention against cancer, enhancing the immune system of the body, respiratory system, cardiovascular system, digestive system, secretion, help extend life,… Substrate for growing Ganoderma lucidum are mainly rubber sawdust from the provinces of Dong Nai, Tay Nguyen in Việt Nam. The use of peanut stem – leaves peanut, peanut shell has solved the environmental pollution, helping to utilize the excess waste and add more substance into mushroom Ganoderma lucidum growing.**

***Index Terms*—ganoderma lucidum, medicinal mushroom, Reishi, ling zhi mushroom, arachis hypogaea**

I. Introduction

Ganoderma lucidum (reishi mushroom, Ling zhi) has been an economically important species particulary in the Far East countries (China, Japan, Korea,…) for over 4000 years [1]. Ganoderma lucidum is a kind of medicinal mushroom possessing anti-tumor, anti-inflammatory, immune-modulatory, antioxidant and other biological traits which render it to be used as medicinal herbs to combat against variety of diseases [2]. Traditionally solid cultivation technique of G. lucidum takes at least several months until fruit bodies are developed. This culture technique is used to obtain basi-diocarp which is used to make tonic or tea. Ganoderma spp. have normally been cultivated in solid substrates such as grain or other lignocellulosic materials such as straw, sawdust and supplements (Riu et al., 1997; Stamets, 2000) [3]. Ganoderma is a large widely distributed genus of the family Polyporaceae (Ganodermataceae), order Aphyllophorales, class Homobasidiomycetes, and division Basidiomycota (Chang 1995, Wasser & Weis 1999) [4]. Ganoderma lucidum is an edible basidiomycetous fungus mostly used in complementary and alternative medicine, particularly in Asian countries for thousands of years (Martinez-Montemayor et al. 2011) [5]. Viet Nam is an agricultural country and annually discharges a large amount of agricultural waste such as peanut stem - leaves peanut, peanut shell making use of agricultural agro-waste from peanut stem – leaves peanut, peanut shell to growing Ganoderma lucidum.

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II. Material and Methods

Preliminary treatment of substrate peanut stem – leaves peanut, peanut shell

The experiment was conducted using mixing peanut stem, leaves peanut, peanut shell

The 2 different substrates were designated and composed as follows:

R0 content of (100% peanut shell (Arachis Hypogaega) + 0,1% KH_2PO_4 + 0,1 % $MgSO_4$).

R1 content of (90% peanut shell (Arachis Hypogaega) + 10% peanut stem, leaves peanut (Arachis Hypogaega)+ 0,1% KH_2PO_4 + 0,1 % $MgSO_4$).

R2 content of (80% peanut shell (Arachis Hypogaega) + 20% peanut stem, leaves peanut (Arachis Hypogaega)+ 0,1% KH_2PO_4 + 0,1 % $MgSO_4$).

R3 content of (70% peanut shell (Arachis Hypogaega) + 30% peanut stem, leaves peanut (Arachis Hypogaega)+ 0,1% KH_2PO_4 + 0,1 % $MgSO_4$).

R4 content of (60% peanut shell (Arachis Hypogaega) + 40% peanut stem, leaves peanut (Arachis Hypogaega)+ 0,1% KH_2PO_4 + 0,1 % $MgSO_4$).

R5 content of (50% peanut shell (Arachis Hypogaega) + 50% peanut stem, leaves peanut (Arachis Hypogaega)+ 0,1% KH_2PO_4 + 0,1 % $MgSO_4$).

R6 content of (40% peanut shell (Arachis Hypogaega) + 60 % peanut stem,leaves peanut (Arachis Hypogaega)+ 0,1% KH_2PO_4 + 0,1 % $MgSO_4$).

R7 content of (30% peanut shell (Arachis Hypogaega) + 70 % peanut stem,leaves peanut (Arachis Hypogaega)+ 0,1% KH_2PO_4 + 0,1 % $MgSO_4$).

R8 content of (20% peanut shell (Arachis Hypogaega) + 80 % peanut stem,leaves peanut (Arachis Hypogaega)+ 0,1 % KH_2PO_4 + 0,1 % $MgSO_4$).

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R9 content of (10% peanut shell (Arachis Hypogaega) + 90 % peanut stem,leaves peanut (Arachis Hypogaega)+ 0,1% KH_2PO_4 + 0,1% $MgSO_4$).

R10 content of (100 % peanut stem,leaves peanut (Arachis Hypogaega) + 0,1% KH_2PO_4 + 0,1 % $MgSO_4$).

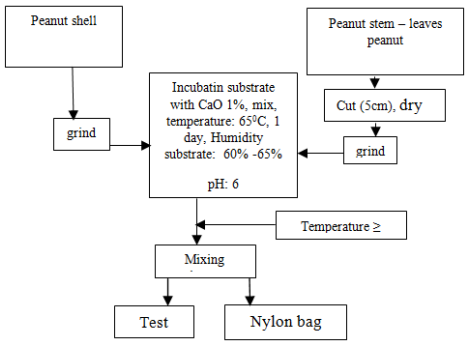


Figure 1. Preliminary treatment of substrate of the peanut stem (Arachis hypogaega), leaves peanut (Arachis hypogaega), peanut shell (Arachis hypogaega) to grow Ganoderma lucidum.

A. *Peanut Stem – Leaves Peanut, Peanut Shell Mixed from R0, R1, R2, R3, R4, R5, R6, R7, R8, R9, R10 Into the Test Tube to Mycelium of G. Lucidum Growing*

The peanut stem – leaves peanut, peanut shell, are pre-treated as shown in Fig. 1, followed by the roasting ratio from R0 → R10 in the test tubes, cotton buttons, packaging, autoclave 121^{0}C, 1 atm, 30 minutes. After 1 day, then transplant G.lucidum and observe mycelium of G.lucidum at 28 degrees.

Each treatment was repeated 3 times. Follow the mycelium for 3 days once.

B. *Peanut Stem – Leaves Peanut, Peanut Shell Mixed from R0, R1, R2, R3, R4, R5, R6, R7, R8, R9, R10 into the Bag Nylon (600 (g)) of G. Lucidum Production*

The volume of each embryo bag is 600 grams. Heat-resistant, long-lasting nylon bag for embroidery.

Use a small shovel to keep the peanut stem – leaves peanut, peanut shells in the bag nylon.

After weighing the required mass, use a small drill to punch the embryo, attach the necks and tie the embryo to the embryo. Not fastened, because it is easy to blast because of the pressure difference.

After sufficient cooking, add the steamed and steamed ingredients at 102^{0}C, 0,9 atm, 8 hours.

Each treatment counted 13 bags nylon.

C. *Data Processing*

Statgraphics centurion XV, Anova: single factor

III. Result and Discussion

A. *Growth of Mycelium G. Lucidum on the base Peanut Stem (A.hypogaea), Leaves Peanut (A.hypogaea), Peanut Shell Mixing of Different Ratios*

The mycelin growth of Ganoderma lucidum in the peanut stem, leaves peanut, peanut shell were mixed at different rates according to from R0, R1, R2, R3, R4, R5, R6, R7, R8, R9, R10. The results of Fig. 3 and Table I. Mycelium of Ganoderma lucidum in all treatments was spread for 3 days and started to adapt to the substrate peanut stem – leaves peanut, peanut shell.

TABLE I. The Mycelium Growth Ganoderma Lucidum (CM) on the Base Peanut Stem (A. hypogaea) - Leaves Peanut, Peanut Shell Mixing of Different Ratios

Treatment	The mycelium growth Ganoderma lucidum (cm) on the base peanut stem (A. hypogaea), leaves peanut (A. hypogaea), peanut shell mixing of different ratios			
	3 days	6 days	9 days	12days
R0	1,52 ±0,1c	3,68 ±0,18fgh	7,96 ±0,16k	11,7 ±0,6s
R1	1,6 ±0,1c	3,69 ±0,09gh	8,1 ±0,1k	12,3 ±0,3t
R2	2,0 ±0,5d	3,72 ±0,1gh	8,5 ±0,1l	12,8 ±0,1v
R3	1,48 ±0,18c	3,48 ±0,08fg	7,95 ±0,15k	11,2 ±0,2q
R4	1,5 ±0,1c	3,57 ±0,07fgh	7,98 ±0,28k	11,4 ±0,1qr
R5	1,46 ±0,16c	3,56 ±0,06fgh	7,9 ±0,1k	11,6 ±0,4rs
R6	1,41 ±0,12c	2,68 ±0,18e	6,5 ±0,1j	8,9 ±0,4m
R7	1,42 ±0,02c	3,58 ±0,02fgh	6,17 ±0,07i	9,3 ±0,1n
R8	1,44 ±0,03c	3,6 ±0,2fgh	6,2 ±0,1i	9,7 ±0,1o
R9	1,38 ±0,08bc	3,46 ±0,26fg	3,8 ±0,1h	10,6 ±0,1p
R10	1,1 ±0,1b	1,4 ±0,1c	3,4 ±0,2f	6,2 ±0,1i

(a,b,c,… show statistical difference, p -value <0,05).

Fig. 3 and Table I is mycelium of Ganoderma lucidum were stronger, whitish and homogeneous. The mycelin growth of R2 on 3 days (2.0 cm ± 0.5d), 6 days (3.72cm ± 0.1gh), 9 days (8.5 cm ± 0.1l), 12 days (12.8 cm ± 0.1v). While the mycelium growth Ganoderma lucidum of R0 12 days (11.7 cm ± 0.6s), R10 12 days (6.2 cm ± 0.1i), the mycelin growth of G. lucidum R2 was faster than that of the mycelin growth R0 and R10, R10 with the slowest 12 days (6.2cm ± 0.1i) This difference was statistically significant (p-value <0.05).

Fig. 2 and Fig. 3: R2 content of (80% peanut shell + 20% peanut stem, leaves peanut+ 0,1% KH_2PO_4 + 0,1 % MgSO4) in the test tube was the best for mycelin Ganoderma lucidum in R2 to achieve optimum after 12 days.

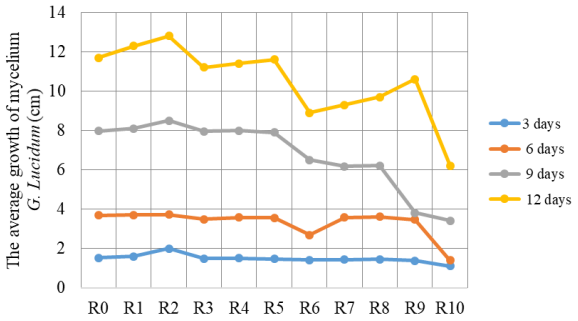


Figure 2. Graph the average growth of mycelium G.lucidum on the base peanut stem (A.hypogaea), leaves peanut (A.hypogaea), peanut shell mixing of different ratios

A 1-3 days A 2 – 6 days A 3 – 9 days A 4 – 12 days

Figure 3. Mycelium growth of Ganoderma lucidum 3 days (A 1), 6 days (A 2), 9 days (A 3), 12 days (A 4).

B. The Weight of Fresh Fruiting Bodies Production of Ganoderma Lucidum on the Substrate Peanut Stem – Leaves Peanut, Peanut Shell Mixing of Different Ratios (R0→ R10)

In house mushroom growing is note the light is not too bright or too dark, mycelium growth (20^0C–23^0C) and fruiting body production (22^0C–28^0C) on the substrate containing peanut stem – leaves peanut, peanut shell mixing of different ratios, air humidity from 80% to 90%. Ganoderma lucidum need good ventilation.

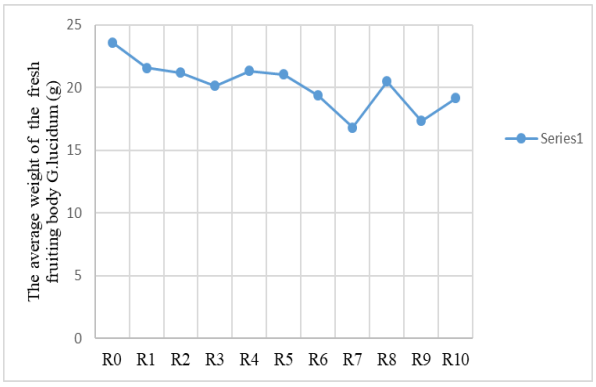


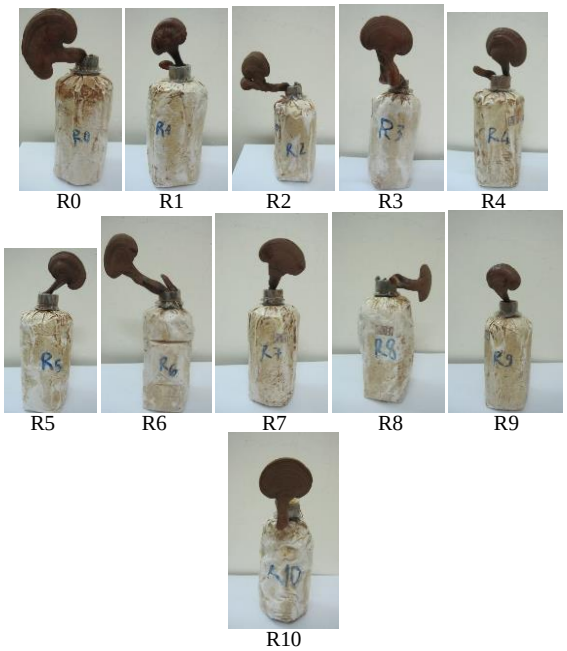
Figure 4. The average weight of the fresh fruiting body production of G.lucidum of R0, R1, R2, R3, R4, R5, R6, R7, R8, R9, R10 on the substrate peanut stem – leaves peanut, peanut shell mixing of different ratios

When harvesting according to each treatment, compare weight of fresh fruiting body of Ganoderma lucidum on the substrate peanut stem – leaves peanut, peanut shell mixing of different ratios R0, R1, R2, R3, R4, R5, R6, R7, R8, R9, R10 (Fresh fruiting body Ganoderma lucidum (g)/nylon bag 600g) in each treatment as shown in Fig. 4 and Fig. 5

As shown in Fig. 4 and Fig. 5, the treatments for the results are distinct. This difference was statistically significant ($\alpha = 0.05$, F = 2.78> F crit = 1.86), R0 have the highest mean yield of 23.6 g / bag nylon 600g, R0 content of (100% peanut shell+ 0,1% KH_2PO_4 + 0,1 % MgSO4). While the R10 content of (100 % peanut stem - leaves peanut + 0,1% KH_2PO_4 + 0,1 % $MgSO_4$) have an average yield of 19.16 g/bag nylon 600g.

TABLE II. SUMMARY WEIGHT OF THE FRESH FRUITING BODY PRODUCTION OF G. LUCIDUM

Groups	Count	Sum	Average	Variance
R0	13	306.8	23.6	50.1535
R1	13	280.54	21.58	16.23833
R2	13	275.47	21.19	4.999333
R3	13	262.08	20.16	17.9997
R4	13	277.42	21.34	37.99577
R5	13	273.65	21.05	25.78813
R6	13	251.94	19.38	26.21617
R7	13	218.64	16.81846	2.819847
R8	13	266.37	20.49	12.359
R9	13	225.68	17.36	1.498233
R10	13	249.17	19.16692	10.35546



R0 R1 R2 R3 R4
R5 R6 R7 R8 R9
R10

Figure 5. Fruiting body Ganoderma lucidum

C. Conclusion

The effect of various kinds of peanut stem - leaves, peanut shell on the weight fresh fruiting body of G.

lucidum was investigated in this study. As described above yield of G. lucidum varied widely depending on the kind of Ro →R10. Therefore it is important to use peanut stem - leaves, peanut shell the proper substrate for the commercial production of G. lucidum,these could have better applicability in low income countries. The present study recommended peanut stem - leaves, peanut shell to be substrate Ganoderma lucidum growth.

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