TẠP CHÍ KHOA HỌC
TRƯỜNG ĐẠI HỌC QUY NHƠN

Nghiên cứu một số đặc điểm sinh học và khả năng sản xuất của nấm Milky *(Calocybe indica)* trồng trên các giá thể khác nhau tại Trường Đại học Quy Nhơn

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TÓM TẮT

Mục tiêu nghiên cứu của đề tài nhằm xác định khả năng sinh trưởng và năng suất nấm Milky (*Calocybe indica*) trong điều kiện nuôi trồng ở thành phố Quy Nhơn, tỉnh Bình Định. Nấm Milky được trồng trên 4 công thức, CT1: mùn cưa + đất phù sa; CT2: mùn cưa + đất phù sa + tro trấu nung; CT3: mùn cưa + đất cát pha; CT4: mùn cưa + đất cát pha + tro trấu nung vào mùa mưa và mùa nắng trên đơn vị diện tích là 30m^2. Kết quả cho thấy nấm Milky nuôi trồng được quanh năm trong điều kiện thời tiết Bình Định. Năng suất cao nhất là ở CT2, mùa mưa năng suất đạt 640,93 kg/1.000 bịch phôi, lợi nhuận đạt là 17.927.200 đồng, mùa nóng năng suất đạt 590,40 kg/1.000 bịch phôi, lợi nhuận đạt là 15.906.000 đồng trong vòng 3,5 tháng. Nhìn chung kết quả nghiên cứu cho thấy nấm Milky (*Calocybe indica*) thích hợp với điều kiện nuôi trồng tại thành phố Quy Nhơn, tỉnh Bình Định, góp phần làm phong phú thêm các loại nấm ăn nuôi trồng ở tỉnh.

Từ khóa*: Nấm Milky, Calocybe indica, cơ chất, khả năng sinh trưởng, năng suất.*

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Study on some biological characteristics and yield capacity of milky mushroom (*Calocybe indica*) cultivated on different substrates at Quy Nhon University

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ABSTRACT

The aim of this study was to determine the ability of growth, and yield for Milky mushroom (*Calocybe indica*) cultivated under climatic conditions in Binh Dinh province. Milky mushroom was cultivated on four different substrates: sawdust + alluvial soil (treatment 1); sawdust + alluvial soil + rice husk ash (treatment 2); sawdust + loamy soil (treatment 3); sawdust + loamy soil + rice husk ash (treatment 4). The experiment was carried out in an area of 30 squarre metres in two seasons: rainy and sunny season. The highest economic yields obtained were 640.93 kg/1000 spawned bags with net profit of 17.927.200 VND for treatment 2 in rainy season and 590.4 kg/1000 spawned bags with 15.906.000VND profit in the duration of 3.5 months. Generally, research results showed that Milky mushroom is suitable with cultivated condition in Quy Nhon of Binh Dinh province, contributing to the enrichment of mushroom cultivated in province.

Keyword: *Milky mushroom, Calocybe indica, substrate, growth ability, yield.*

1. INTRODUCTION

Like other mushrooms, milky mushroom (*Calocybe indica* P&C) have sweet taste and coldness. The nutrition values of Milky mushrooms are rich in protein, vitamins and minerals. Krishnamoorthy *et al.* reported 32.2% protein (dry weight) in a medium sized milky mushroom.[1] Vitamin content of Milky mushroom is higher than that of Abalone mushrooms (Oyster mushroom).[1,2] Most of the mushrooms are rich in B complex vitamins (thiamine, riboflavin, pridoxine, pantothenic acid, nicotinic acid, nicotinamide, folic acid, and cobalamin); as well as ergosterol and biotin, vitamin A in fresh and dry Milky mushrooms have been reported to be 0.35 mg and 0.275 $mg.g^{-1}$, respectively.[3] Water soluble vitamin C (a free radical scavenger and a well-known antioxidant and inhibitor of lipid peroxidation has been reported in fresh and dry white milky mushrooms (1.03 and 0.4 mg/100 g, respectively).[4] Mushrooms are a good source of biological active compounds that protect the human body against several chronic and degenerative diseases. Milky mushrooms are rich in ergothioneine (an antioxidant that protects body parts for fighting against free radical). The beta-glycans present in dietary fibers of mushrooms are reported to have stimulatory effect on immune system with anti-mutagenic, anticancer and antitumor activities.[5] Mushrooms

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are good sources of minerals (Ca, K, Mg, Na, and P), trace elements (Cu, Fe, Mn, and Zn) and sometimes, toxic heavy metals (Cd and Pb) as compared to vegetables.[6]

Milky mushroom was introduced to Vietnam in 2007, and grown widely in many provinces such as Hanoi, Ninh Binh, Da Nang, Ho Chi Minh city, etc. But the study on biological characteristics of this mushroom is very limited[7]. In 2015, Milky mushroom was introduced and cultivated at the Center for Applied Science and Technology of Binh Dinh province in the first study and evaluation of its biological characteristics. However, the research was carried out in small-scale at one season.

Based on the listed reasons, it is necessary to study some biological characteristics and yield capacity of Milky mushroom grown on different substrates at Quy Nhon University.

2. MATERIALS AND METHODS

2.1. Experimental design

First grade mycelia were cultured in vitro on PGA (potato, glucose, agar) medium, and secondary grade mycelia were cultured in sterilized paddy grains. For sprawn media, base substrate (BS) of 250 kg of sawdust + 5 kg of lime powder + 20 kg of rice bran + 100 liters of water. The experiment consists of treatments: Treatment 1: 51 kg of BS + 5 kg of alluvial soil; Treatment 2: 51 kg of BS + 5 kg of alluvial soil + 2 kg of rice husk ash; Treatment 3: 51 kg of BS + 5 kg of sandy soil; Treatment 4: 51 kg of BS + 5 kg of sandy soil + 2 kg of rice husk ash.

Sterilized substrates were mixed according to the ratio of each treatment. The substrate was then transferred into polypropylene bags of 20 x 36 cm in sizes, the openings of the bags were plugged with cotton and secured with plastic rings. The average weight of spawn bag is from 1.6 kg to 1.7 kg. Each treatment includes 30 spawn bags. The experiment was conducted in rainy season (RS) from September to November and dry season (DS) from May to July.

2.2. Indicator measurements

Contamination rate (%) – the rate of contaminated bags, length and diameter of stalk (cm) – measure on fruiting bodies at harvest, thickness of mushroom pileus (cm) – measure at thickest pileus part, biological yield (g/spawned bag) – total fresh mass of harvested fruiting bodies, economic profit (VND/1000 bags) – the income after deducting expenses.

2.3. Statistical analysis

The data of experiment were statistically analyzed using MS. Excel and Statistix 8.0.

Table 1. Contamination rate of culture media (%)

Media for	Bag total	Amount of contaminated bags	Amount of uncontaminated bag	Contamination rate (%)	Successful rate (%)
Grade 1 mycelia	20	1	19	5	95
Grade 2 mycelia	20	2	18	10	90
Spawning in RS	150	4	146	3.3	96.7
Spawning in DS	150	5	145	4	96

The data from Table 1 shows that the contamination rates differ from the different media: PGA medium for grade 1 mycelia (5%), sterilized paddy for grade 2 mycelia (10%), spawn media in rainy season (3.3%) and in dry season (4%). The results showed that Milky mushroom has high resistance in local condition. The rate of spawning success could search to 96.7%.

3. RESULTS AND DISCUSSIONS

3.1. Contamination rate

The contamination rate of cultivation media is one of the criteria to evaluate the mushroom adaptability. The results are presented in Table 1.

3.2. Mycelial growth rate of Milky mushroom

The mycelial growth rate of mushroom is assessment indicator of growth and development in mushroom cultivation. The results of mycelial growth on cultural media are presented in Table 2.

Table 2. Mycelial growth rate of Milky mushroom (days)

Media for	Half mycelial colonization	Complete mycelial colonization
Grade 1 mycelia	12	21
Grade 2 mycelia	20	35
Spawn bags	29	47

The data shows that the mycelial growth rate of Milky mushroom is different in the culture media: PGA medium for grade 1 mycelia (21 days), sterilized paddy for grade 2 mycelia (35 days), and spawn bag (47 days). Thus, the mycelial growth rate of Milky mushrooms is relatively slow in comparison with other mushrooms, such as abalone mushroom: 15 - 16 days, 20 - 25 days, and 25 - 26 days respectively.

3.3. Growth time period of Milky mushroom

The collected data of growth periods (Table 3) show that the growth time of Milky mushroom ranged from 19 to 21 days in the rainy season, and 21 to 24 days in the dry season. The growth time of Treatment 2 was faster than that of other Treatments 1 - 2 days in rainy season and 1 - 3 days in dry season. Treatment 3 has the slowest growth rate.

Table 3. Growth and development time period of Milky mushroom (days)

Treatment	Rainy season				Dry season			
	Complete mycelia in spawn	Fruiting body initiation	Mushroom fruiting body production	Harvesting	Complete mycelia in spawn	Fruiting bodies initiation	Mushroom fruiting body production	Harvesting
Treatment 1	1	8	10	20	1	10	12	22
Treatment 2	1	7	9	19	1	9	11	21
Treatment 3	1	9	11	21	1	12	14	24
Treatment 4	1	9	11	21	1	11	13	23

3.4. Growth characteristics of Milky mushroom

There are many types of culture media with different nutrient compositions that can be used for the vegetative growth of mushrooms. In this experiment, four different culture substrates were screened to determine the suitable substrate for mycelial growth of Calocybe indica. As shown in Table 4, Milky mushroom was able to grow on all four types of substrate tested.

3.4.1. Length of stalk

The descriptive dimensions of fruiting bodies and yield of Milky mushroom in different substrates were presented in Table 4.

Table 4. Length of stalk, thickness of pileus and yield of Milky mushroom

Treatment	Rainy season			Dry season		
	Length of stalk (cm)	Thickness of pileus (cm)	Biological yield (g/bag)	Length of stalk (cm)	Thickness of pileus (cm)	Biological yield (g/bag)
Treatment 1	11.99b	2.59b	571.57bc	11.93b	2.57b	478.00b
Treatment 2	13.47a	2.81a	640.93a	13.20a	2.79ab	590.40a
Treatment 3	11.79b	2.44b	563.70c	11.30b	2.33bc	421.50b
Treatment 4	13.01ab	2.61ab	600.53bc	12,90a	2.57b	485.60b
CV(%)	13.51	13.39	1.32	10.78	14.16	14.42
$LSD_{0.05}$	1.07	0.21	56.22	0.83	0.30	36.90

In a column the same letters indicate that the values are not significantly different by LSD (least significant difference)'s test at significance level of 0.05; CV (coefficient variance).

The data from Table 4 shows that the length of mushroom stalks of treatments are different and Treatment 2 has the highest stalk (13.47cm and 13.20 cm, respectively in the rainy season and dry season). The difference of the length of mushroom stem in rainy and dry seasons is not statistically significant. The length of mushroom stalk would be not affected by weather conditions.

3.4.2. Diameter of stalk

The stem of Milky mushroom has bowling pin-like shape. The diameters of stalk were thus measured at three positions of stalk (the neck, the middle and the base of the mushroom stalk). The data of stalk diameter is shown in Table 5.

Table 5. Diameter of Milky mushroom stalk (cm)

Treatment	Rainy season				Dry season			
	Stalk neck	Middle stalk	Base stalk	Mean	Stalk neck	Middle stalk	Base stalk	Mean
Treatment 1	2.25b	2.77b	3.09b	2.70ab	2.15b	2.61b	3.12b	2.62ab
Treatment 2	2.68a	3.52a	3.93a	3.38a	2.46a	3.27a	3.92a	3.22a
Treatment 3	2.21b	2.65b	3.06b	2.64ab	2.11b	2.54b	3.05b	2.56ab
Treatment 4	2.67a	3.43a	3.84a	3.26a	2.20b	2.68b	3.21b	2.70ab
CV(%)	15.18	14.80	14.84	14.98	15.20	14.50	13.05	11.77
$LSD_{0.05}$	0.24	0.23	0.34	1.01	0.22	0.25	0.27	1.11

In a column the same letters indicate that the values are not significantly different by LSD (least significant difference)'s test at significance level of 0.05; CV (coefficient variance).

The results showed that the stalk diameter of Milky mushroom cultivated in different substrates varied from 2.64 to 3.38 cm in the rainy season and from 2.56 to 3.22 cm in the dry season. The diameter of stalk is highest in Treatment 2. There is not statistically significant difference between the treatments. However, the diameter of mushrooms stalk cultivated in rainy season is larger than that in dry season. Thus, the diameter of stalk would be affected by weather and the culture substrate has little effect.

3.4.3. Thickness of mushroom pileus

The thickness of the Milky mushroom pileus in the treatment is from 2.44 to 2.81 cm in the rainy season and from 2.33 cm to 2.79 cm in the dry season. There is not significant difference of the thickness of mushroom pileus that cultivated in rainy season and dry season, but the difference of thickness of mushroom pileus of treatments has statistically significant.

3.4.4. Biological yield of Milky mushroom fruiting bodies

The biological yield of mushrooms is an important criterion which is used to evaluate the cultivation and production capacity in local culture condition. Based on the biological yield, the economic efficiency is evaluated at the end of harvest. The collected data of are presented in Table 4.

The results indicate that the highest and lowest biological yields were Treatment 2 (640.93 g/spawned bag) and Treatment 3 (421.50 g/spawned bag). The difference of biological yield of mushroom that cultivated in rainy and sunny seasons is statistically significant. Thus, the substrate composition has an influence on harvested fruiting body mass. Specifically, the substrate which is added with rice husk ash and alluvial soil has highest biological yield. In addition, the growth capacity of Milky mushroom cultivated in the rainy season is better than that in the dry season. The lower temperature and higher air humidity in rainy season could be main factors. So, the rainy season is suitable for Milky mushroom cultivation.

4. ECONOMIC EFFICIENCY

Table 6. Economic efficiency of Milky mushroom production (calculation for 1000 spawn bags)

Treatment	Production cost (1000 VND)	Rainy season			Dry season		
		Yield (kg)	Revenue (1000 VND)	Profit (1000 VND)	Yield (kg)	Revenue (1000 VND)	Profit (1000 VND)
Treatment 1	7.710	571.57	22.862	15.152	487.00	19.120	11.410
Treatment 2	7.710	640.93	25.637	17.927	590.40	23.616	15.906
Treatment 3	7.710	563.70	22.548	14.838	421.50	10.860	9.150
Treatment 4	7.710	600.53	24.021	16.311	485.60	19.424	11.714

(Current price of milky mushroom: 40.000 VND/kg)

The analysis data indicate that the cost of 1000 spawn bags is same at different treatments (7.710.000 VND). Treatment 1 has the highest profit (17.927.200 VND), followed by Treatment 4 (16.311.200 VND), Treatment 1 (15.152.000 VND) and Treatment 3 has the lowest profit (14.838.000 VND) in the rainy season cultivation. In the dry season cultivation, the highest profit reached to 15.906.000 VND at Treatment 2, then Treatment 4 (11.714.000 VND), Treatment 1 (11.410.000 VND) and Treatment 3 has the lowest profit (9.150.000 VND).

4. CONCLUSIONS

The survey results of Milky mushroom cultivation in four different substrates conclude that Milky mushroom has good resistance. The rate of spawning success of media could search to 96.7%. The substrate added 5 kg of alluvial soil and 2 kg of rice husk ash was considered to be the most suitable substrate to cultivate Milky mushroom to get the high yield and the good profit. Milky mushroom is suitable for the weather conditions in Binh Dinh province. Milky mushroom cultivation could thus realize in the duration of all year and become a livelihood for local farmers.

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