Impact of Gamma Radiation on the Productivity and Quality of First Generation Mutant Oyster Mushroom - *Pleurotus osteratus* (Jacq.ex Fr.) P.K.umm

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Abstract

The present research deals with the part of the induced mutation plant breeding.Oyster mushroom sample (Ngwe-Hnin-Mho) was collected from Kaung-Ei Mushroom Nursery, South-Okkalapa Township, Yangon Region.The samples of mushroom were treated with different doses (0.25, 0.5, 0.75 and 1 kGy) of gamma radiation respectively.After irradiation, these samples were cultivated and studied qualities and yield of oyster mushroom from first generation (M_1).After harvested M_1 generation, induced activity of mutant samples were determined and there were no induced activity in these mutant mushrooms.Agronomical characteristics (yields, shelf-life, fruiting period), nutritional values and antioxidant activity of mutant oyster mushroom were determined. According to the nutritional point of view, there is no observed the significant changes of nutritional values between irradiated samples and control.From this study , it was found that the yields of all OMG (Gamma Irradiated Oyster Mushroom) samples were increased in OMG 0.25(7.6 %), OMG 0.5(11.5 %), OMG 0.75(29.2 %), OMG 1(17.6 %) respectively. The shelf-life of OMG samples is about 6 hours prolong than control. It was found that fruiting period of OMG 0.75 was the shortest among the OMG samples.From the screening of free radical scavenging activity by DPPH assay on ethanol extracts of OMG 0.25, OMG 0.5, OMG 0.75, OMG 1 were studied and compared with control. It was found that IC_{50} value of ethanol extracts from OMG 0.25, OMG 0.5, OMG 0.75, OMG 1 were 225.54, 204.00, 134.50, 223.45 µg/mL respectively. Among these extracts, it was observed that OMG 0.75 has the most effective antioxidant activity.

Keywords: oyster mushroom, gamma, induced mutation plant breeding, OMG

Introduction

Mushroom is an attractive crop to cultivate in developing countries for many reasons. One of most charming point would be that they are grown on agricultural wastes. It enables us to acquire substrate materials at low prices or even for free and to conserve our environment by recycling waste. Most of all, oyster mushroom (*Pleurotus* spp.) can utilize various kinds of substrate materials than any other mushrooms.Oyster Mushroom (*Pleurotus* spp.) is an edible mushroom that gained popularity lately due to its nutritional values and ease of cultivation. Oyster mushroom cultivation can be considered environmental friendly because utilizing recycled materials such as sawdust, corn and other waste materials such as old rubber trees which is abundant in rubber plantations (Aletor, 1995) .

White oyster mushroom contains higher amount of protein, lipid and riboflavin compared to other edible mushroom.Fresh oyster mushrooms have a high water content so drying them is an effective way to both prolong their life-time and preserve their flavor and nutrients (Dung , 2012). Some mushrooms are more difficult to grow than others and if there

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is little available expertise locally, farmers start with easy species likes Oyster Mushrooms(*Pleurotus* species) which grow on many substrates and then returned to the land fertilizer (Breene, 2010). Oyster mushrooms are a good choice for inexperienced cultivators because they are easier to grow than many other species.

One way to introduce genetic variability is through mutation using chemical agents or ionizing radiations.Irradiation including Gamma rays (Co-60) application has been used frequently in reducing or preventing spoilage of mushroom (Chang, 1999). Mutation may induce one or more change in characteristics of mutant organisms. The characteristic changes may be occurred at the gene level which may be passed to the next generation. Mutation is applied to edible mushrooms to obtain better quality and productivity. The desired mutant characteristics can be economically beneficial for example resistance to fungicide, higher yield, weight etc (Dijajanegara and Harsoya, 2008).

Materials and Methods

Firstly, the spawn of mushrooms sample were collected from Kaung-EiMushroom Nursery, South Okkalapa Township, Yangon Region. The spawn of mushrooms were transported to the Department of Atomic Energy, Ministry of Science and Technology for irradiation.

And then, the spawn of oyster mushroom were cultivated in various dose of oyster mushroom (0.25, 0.5, 0.75, 1kGy). Oyster mushrooms were firstly cultivated on rubber tree logs and are commonly grown on sawdust. Cultivation merely involved placing the sterilized and inoculated substrate in plastic bags, keeping them in the cool and dark. The mycelium has grown throughout the substrate, openings are cut through the bag to allow fruiting bodies (fruiting mushroom) to develop.

For study on safety consumption of mutant of first generation (0.25, 0.5, 0.75, 1kGy) the induced activity was monitored by NaI (Tl) Scintillation Gamma Counter at Nuclear Chemistry Laboratory,Yangon.

The study on investigation of agronomical characteristics mutant of oyster mushroom from first generation (0.25,0.5,0.75,1 kGy) were determined.For study on nutritional qualities of mutant of oyster mushroom from generation (OMG 0.25, OMG 0.5, OMG 0.75, OMG 1) were determined by AOAC method. The study on antioxidant activity of mutant of oyster mushroom from firstgeneration were determined by DPPH assay method.




(a) Spawn of oyster mushroom (b) Substrate Preparation (c) Bagging (d) Pasteurization



(e) Putting spawn into bags mushroom (f) Sealed bags (g) Fruiting

Figure 1. Cultivation Procedure of Oyster Mushroom

Results and Discussion

Study on Safety Consumption of γ-Irradiated Mutant Oyster Mushroom

The induced activity of each mutant sample (OMG 0.25, OMG 0.5, OMG 0.75, OMG 1) was monitored by using NaI (Tl) Scintillation Gamma Counter at Nuclear Laboratory, Department of Chemistry. Since the induced radioactivity of each irradiated sample was monitored for safety consumption. It can be observed that there is no activity on the background for both before and after cultivation of M_1generations.It was found that there were no induced activity in this samples.Thus, they are safe for consumption.Hence, gamma irradiation mutant samples of oyster mushroom in each generation can be handled, stored and are safe for consumption.

Table1. Monitoring of Induced Radioactivity in Mutant of Oyster Mushrooms in First Generation (after harvested)

No.	Samples	Induced activity relative to background (±%) (cp 300s) M_1 generation
1	OMG 0.25	1.50
2	OMG 0.5	0.55
3	OMG 0.75	0.97
4	OMG 1	1.11

± = due to fluctuation Note: activity no distinct above background

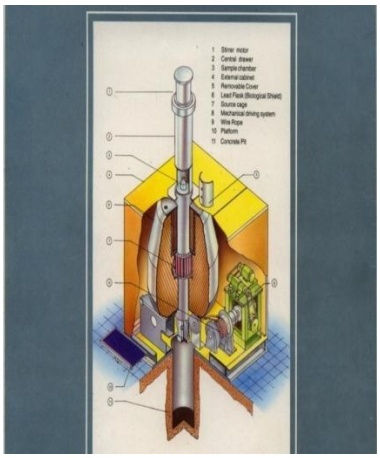


Figure 2. Co-60 gamma radiation source

Study on Agronomical Characteristics of mutant Oyster Mushroom samples in first generation

From this study, it was found that OMG 0.25 has increased yield (7.6 %) and shelf –life (5 hours) .The shelf life are all OMG sample more prolong than control.It was cleared found that fruiting period OMG 0.75 more shorter than control . Therefore, OMG 0.75 sample provide the highest yield with shorter fruiting period. From point of view, gamma irradiation is effective on the shelf-life, yield and fruiting period of oyster mushroom.

(a)

(b)

Figure 3. Photographs of (a) non-irradiated oyster mushroom and (b) irradiated oystermushroom

Table 2. Agronomical Characteristics of mutant Oyster Mushroom samples in First Generation

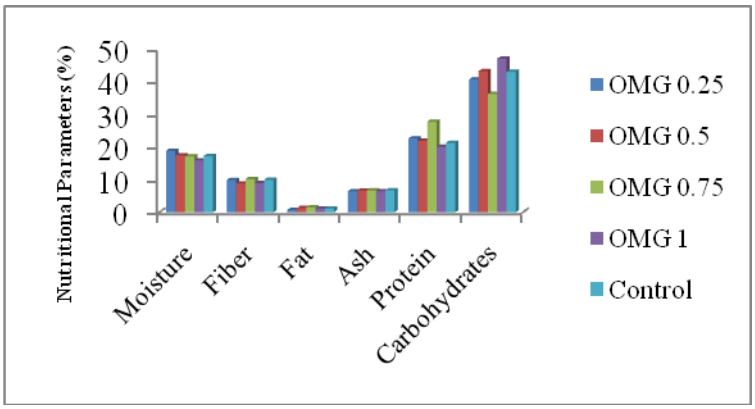
NO	Characteristics of Oyster Mushroom	Samples				
		Control	OMG 0.25	0MG 0.5	OMG 0.75	OMG 1.0
1	Weight / bag (g)	223.33 ± 20.67	233.33 ± 8.17	241.67 ± 9.57	291.67 ± 20.34	251.67 ± 24.83
2	Relative Yield	100	107.6	111.5	129.2	117.6
3	Yield Increase (%)	-	7.60	11.50	29.20	17.60
4	Shelf – life (h)	18	23	24	24	24
5	Fruiting Period (days)	34	34	34	31	33

Study on the Nutritional Values of Mutant Oyster Mushroom in First Generation

From this study (Table3), the nutritional qualities of mutant of oyster mushroom from first generation (OMG 0.25,OMG 0.5, OMG 0.75,OMG 1) were determined by AOAC method.As a result, there is no significant differences between OMG samples and control.

Table 3. Nutritional Values of Mutant Oyster Mushroom in First Generation

NO	Nutritional Parameters	Percent (%)				
		OMG 0.25	OMG 0.5	OMG 0.75	OMG 1	Control
1	Ash	6.54	6.73	6.74	6.52	6.82
2	Carbohydrate	40.94	43.46	46.44	47.28	43.28
3	Fiber	9.98	8.89	10.22	9.01	10.02
4	Fat	0.81	1.32	1.51	1.18	1.18
5	Moisture	18.95	17.54	17.20	15.99	17.35
6	Protein	22.78	22.06	27.89	25.2	21.35



OMG 0.25 = Gamma 0.25 kGy irradiated Oyster Mushroom
OMG 0.5 = Gamma 0.5 kGy irradiated Oyster Mushroom
OMG 0.75 = Gamma 0.75kGy irradiated Oyster Mushroom
OMG 1 = Gamma 1 kGy irradiated Oyster Mushroom

Figure 4. A bar graph of nutritional values of mutant Oyster Mushroom samples in first generation

Study on the Elemental Determination of Mutant Oyster Mushroom in First Generation

In this work, some elemental content in mutant of oyster mushrooms from first generations were also investigated by AAS method.From the study on elemental content of mutant oyster mushrooms from generation, it was found that there are six elements, Fe, Cu, Mg, Ca, Mn, Zn were detected in each generation and content of elements in mutant samples did not differ distinctively from those of control.From these observations, it can be observed that the effect of irradiation on the elemental content of oyster mushroom is not significant. Therefore, it can be inferred that irradiation had no detrimental effect on elemental contents of oyster mushroom.

Table 4. Determination of Some Elemental Contents of Mutant Oyster Mushroom Samples in First Generation (M_1)

No	Samples	Elemental content (%)					
		Fe	Cu	Mg	Ca	Mn	Zn
1	OMG 0.25	0.007	0.005	0.0728	0.003	0.001	0.014
2	OMG 0.5	0.005	0.003	0.0663	0.003	0.001	0.012
3	OMG 0.75	0.006	0.003	0.067	0.005	0.001	0.012
4	OMG 1	0.005	0.005	0.068	0.001	0.001	0.019
5	OMC	0.005	0.009	0.067	0.009	0.001	0.012

OMG 0.25 = Gamma 0.25 kGy irradiated Oyster Mushroom
OMG 0.5 = Gamma 0.5 kGy irradiated Oyster Mushroom
OMG 0.75 = Gamma 0.75kGy irradiated Oyster Mushroom
OMG 1 = Gamma 1 kGy irradiated Oyster Mushroom

Study on Gamma Irradiation on Antioxidant Activity of Mutant of Oyster Mushroom in First Generation

From the screening of free radical scavenging activity by DPPH assay on ethanol extracts of OMG 0.25, OMG 0.5, OMG 0.75, OMG 1 were studied and compared with control (Table 5). It was found that IC_{50} value of ethanol extracts from OMG 0.25, OMG 0.5, OMG 0.75, OMG 1 were 225.54, 204.00, 134.50, 223.45 µg/mL respectively. Among these extracts, it was observed that OMG 0.75 has the most effective antioxidant activity.

Table 5. Inhibition % and IC_{50} Values of Ethanol Extracts of Mutant of Oyster Mushroom from First Generation

Samples	Percent inhibition of various concentrations of ethanol extract (Mean ± SD)					
	25 µg/mL	**50 µg/mL**	**100 µg/mL**	**200 µg/mL**	**400 µg/mL**	**IC_{50} µg/mL**
0MG 0.25	10.43 ± 2.42	32.31 ± 1.32	39.57 ± 2.32	57.13 ± 4.53	73.46 ± 9.72	225.54
0MG 0.5	9.86 ± 1.85	11.21 ± 1.92	15.85 ± 3.35	25.59 ± 0.81	57.41 ± 3.46	204.00
OMG 0.75	9.49 ± 2.57	12.29 ± 3.66	54.32 ± 0.59	62.04 ± 0.30	79.14 ± 1.09	127.52
OMG 1	7.49 ± 0.36	15.69 ± 1.96	41.35 ± 1.70	49.17 ± 2.55	57.82 ± 1.21	134.50
Control	2.10 ± 0.36	7.49 ± 1.94	15.69 ± 1.70	29.41 ± 2.55	51.82 ± 1.49	223.45

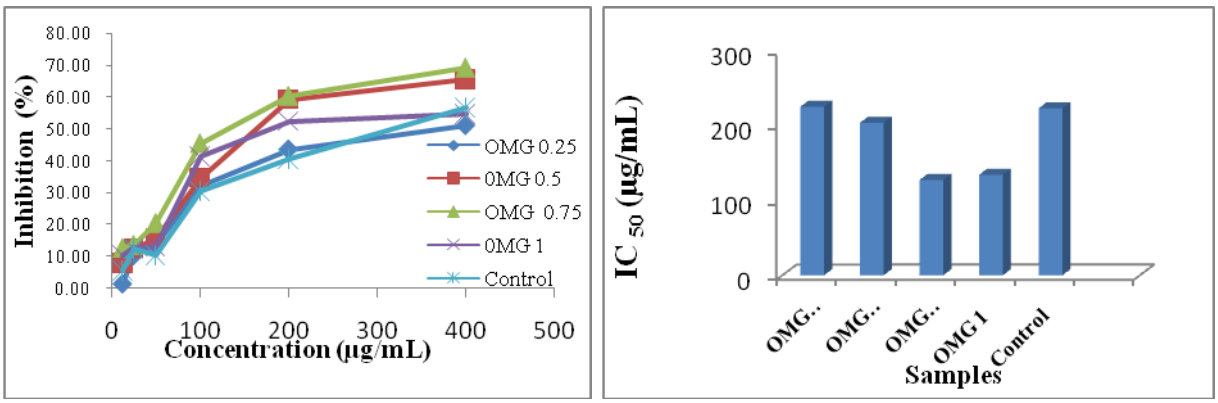


Figure 5. IC_{50} values of mutant Oyster Mushroom samples in first generation

Conclusion

In this work, effects of mutant of first generation on oyster mushrooms were studied. From results, all irradiated oyster mushroom have no induced activity.Therefore,it is safe for consumption , handle and storage. From study on agronomical characteristics of mutant oyster mushroom, the shelf-life all OMG samples more prolong than control.Among them, OMG 0.75 is more increase yield than other irradiated sample. It was clever found that fruiting period of OMG 0.75 shorter than other.Therefore, gamma irradiation is effective on the shelf-life, and yield and fruiting period of oyster mushroom.From study on nutritional values, there are no significant differences between OMG samples and control. From overall results, OMG 0.75 sample provides the highest yield with shorter fruiting period.There is no observed

significant change between OMG samples and control. The screening of free radical scavenging activity of OMG 0.75 is more effective than other samples. Moreover, the shelf-life of this sample is more prolonged. Therefore, 0.75 dose of gamma irradiation (OMG 0.75)is the most excellent one in this work.

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