Radiation-induced mutation of Pleurotus sajor-caju for the improvement of mycelial growth, productivity of fruiting bodies and generation of bioactive compounds with radioprotective properties

Doctoral Dissertation Abstract

Name Rosnani binti Abdul Rashid

1. Dissertation Title (If in English, add the Japanese translation.)

Radiation-induced mutation of *Pleurotus sajor-caju* for the improvement of mycelial growth, productivity of fruiting bodies and generation of bioactive compounds with radioprotective properties

菌糸の成長、子実体の生産性、および放射線防護特性を持つ生理活性物質の生成を改善するための放射線照射によるハイイロヒラタケの突然変異誘発

2. Abstract (Roughly 2,000 Japanese characters or 800 English words)

The International Atomic Energy Agency (IAEA) actively promotes the use of radiation and radioisotopes in research and their applications in industry, agriculture and medicine. Knowledge of radiation effects on plants, microbes and living organisms are prerequisites in radiation application in these socio-economic sectors. Mutation induction by radiation is important for improving useful traits and selected characteristics of plants as well as mushrooms due to market niche and challenges faced by the industries. The aim of this study to investigate and clarify the effects of the gamma radiation prior to mutagenesis of *Pleurotus sajor-caju* with the improvement characteristics such as better size, high productivity and bioactive compounds. These improvement characteristics and findings from this study have a great potential and application to support and expanding the agriculture and medicine nuclear industry.

In this study, the effects of gamma radiation of *P. sajor-caju* on mycelial growth and productivity was conducted at Malaysia Nuclear Agency. Irradiation of *P. sajor-caju* mycelia was carried out at the Biobeam GM 800 radiation facility, Malaysian Nuclear Agency using caesium-137 as the gamma source at LD_{50} dose of 2.2 kGy, with dose rate of 0.227 Gy s-1. Non-irradiated mycelia were used as control. The irradiated mycelia of *P. sajor-caju* were measured after radiation for 12 days with 3 days interval. The fastest

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growing and healthy mycelia were selected for the cultivation in baglogs of saw dust substrate. At this stage, the mycelial growth also was measured once a week until the mycelia fully covered the substrate. The bags of mycelia covered substrate were opened for fruiting. Data for morphologies and yield were recorded. The findings showed that γ-rays can reduce the growth rate of mycelia, while inducing the size of fruiting bodies with length up to 7.2 cm and productivity up to 92.56 %.

The bioactive compounds derived from the fruiting bodies have various medicinal properties, such as antioxidant and support the immune system with mitigating the harmful effects of radiation. In this present study, extracts of bioactive compounds *P. sajor-caju* were investigated for antioxidant properties and radioprotective effects on wild type of yeast cells. The fruiting bodies from the study mentioned above were used. The bioactive compounds in non-irradiated and irradiated *P. sajor-caju* were extracted from the dried powder of fruiting bodies using either water, ethanol, or azeotropic solvents (80% ethanol: 20% water) separately. Each extract was then filtered using a vacuum pump with filter paper, evaporated using a rotary evaporator to concentrate the extracts, and freeze-dried for 24 hours. The total phenolic content (TPC) of the extracts was determined by Folin–Ciocalteu assay and the total flavonoid content (TFC) was determined by aluminum chloride assay. The antioxidant activities were determined by performing 2,2-diphenyl-1-picrylhydrazyl (DPPH) and ferric reducing antioxidant power (FRAP). The radioprotective effects of the extracts on yeast cells were conducted using ^{60}Co γ-rays at the Radiation Laboratory in the Institute of Scientific and Industrial Research, Osaka University, at doses of up to 150 Gy and dose rates of 0.83–3.30 Gy min-1. The effects were evaluated based on the survival rate (SR) and mutation frequency of yeast cells. The results shown the SR of yeast cells increased while those undergoing mutation decreased in presence of extracts *P. sajor-caju*. These indicated the extract of gamma irradiated *P. sajor-caju* has a higher radioprotective effect than the extract of non-irradiated *P. sajor-caju* by reduce the damage induced by γ-rays on yeast cells.

The results from these studies on the effects of gamma radiation for the improvement of characteristics and bioactive compounds of *P. sajor-caju* with radioprotective properties suggested that the possibility of gamma radiation increased the size and productivity of fruiting bodies, as well as bioactive contents of *P. sajor-caju* with radioprotective properties by protecting yeast cells against damage from ionizing radiation such as γ-rays.