ISSN: 1412-033X
E-ISSN: 2085-4722

BIODIVERSITAS

Journal of Biological Diversity

Volume 22 - Number 1 - February 2021

BIODIVERSITAS

Journal of Biological Diversity

Volume 22 – Number 2 – February 2021

ISSN/E-ISSN:
1412-033X (printed edition), 2085-4722 (electronic)

PUBLISHER:
The Society for Indonesian Biodiversity

CO-PUBLISHER:
Department of Biology, Faculty of Mathematics and Natural Sciences, Sebelas Maret University, Surakarta

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ONLINE:
biodiversitas.mipa.uns.ac.id; smujo.id/biodiv

Society for Indonesia Biodiversity

Sebelas Maret University Surakarta

Published by Smujo International for The Society for Indonesian Biodiversity and Sebelas Maret University Surakarta

(https://smujo.id/biodiv/issue/view/287)

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BIODIVERSITAS
Volume 22, Number 2, February 2021
Pages: 684-690

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d220220

The characteristics of fermented purple sweet potato (*Ipomoea batatas*) and black rice (*Oryza sativa*) using UV-irradiated *Monascus purpureus*

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Manuscript received: 2 December 2020. Revision accepted: 11 January 2021.

Abstract. *Novita I, Oedjijono, Asnani A. 2021. The characteristics of fermented purple sweet potato (*Ipomoea batatas*) and black rice (*Oryza sativa*) using UV-irradiated* Monascus purpureus. *Biodiversitas 22: 684-690.* This research aimed to produce *Monascus* fermented product (MFP) with purple sweet potato (*Ipomoea batatas* (L.) Lam.) and black rice (*Oryza sativa* L.) using UV-irradiated *Monascus purpureus* Went and evaluated the characteristic of its antibacterial activity against *Salmonella typhi*. *M. purpureus* was irradiated with UV at λ254 nm for 0, 2, 3, and 4 min. The solid-state fermentation process was carried out for 7, 14, and 21 days. The pigments were measured at λ390 nm for yellow and λ500 nm for red. The ethanol extracts of MFP were analyzed for their antibacterial activity against *S. typhi* using the Kirby–Bauer method. The results showed that the highest yield of MFP was obtained from MFP–black rice (51.88%) that used UV-irradiated *M. purpureus* for 2 min and fermentation for 21 days. The highest absorbance value of MFP–purple sweet potato was obtained from UV-irradiated *M. purpureus* for 3 min, whereas the highest absorbance value of MFP–black rice was obtained with UV-irradiated *M. purpureus* for 2 min. Ethanol extracts of both MFP3–purple sweet potato and MFP2–black rice showed antibacterial activities against *S. typhi* with minimum inhibitory concentration values of 0.2 and 0.15 g/mL, respectively. Thin-layer chromatography analysis of the ethanol extract from MFP2–black rice revealed the presence of bioactive saponin and flavonoid. These findings suggest that UV-irradiated *M. purpureus* was able to use both purple sweet potato and black rice substrates to produce MFP with antibacterial activity against *S. typhi*.

Keywords: Black rice, fermentation, *Monascus*, purple sweet potato, UV-irradiated

INTRODUCTION

Monascus purpureus Went is a filamentous fungus with known potential for natural pigment production through submerged or solid-state fermentation (Christiana 2016). During fermentation, *M. purpureus* will utilize starchy substrates and produce secondary metabolites in the form of pigments. Based on the color, *Monascus* pigments are classified into three categories, including red (monascorubramin and rubropunctamin), yellow (monascin and ankaflavin), and orange (monascorubrin and rubropunctatin) (Kim and Ku 2018). These pigments are widely used in the Asian region as a natural food colorant and as health products because of their bioactivities (Srianta et al. 2014).

Production of *Monascus* fermented product (MFP) is affected by the type of nutrients as well as physicochemical conditions such as pH, temperature, moisture content, dissolved oxygen concentration, and light. Bühler et al. (2015) observed that light intensity is an essential factor in the mycelium growth and pigment production of *Monascus*. Indeed, monacolin K produced by ultraviolet (UV)-irradiated *Monascus* was three times greater than the control culture (Sun et al. 2011). Monacolin K, commercially known as lovastatin, is a potent competitive inhibitor of 3-hydroxy-3-methylglutaryl coenzyme A (HMG-CoA) reductase, inhibits cholesterol biosynthesis, and lowers blood cholesterol levels in both humans and animals. UV-mutated *M. purpureus* TISTR 3179 was used to produce a yellow pigment at a single λ_{max} 370 nm (Yongsmith et al. 2013). Huang et al. (2019) mutated *Monascus* spores using UV irradiation and ethyl methane sulfonate (EMS) for higher monacolin K and red pigment productions. The importance of light intensity in the fermentation process indicates that *Monascus* probably has photoreceptors that influence the physiological responses.

Rice is mainly used as a substrate for centuries (Pattanagul et al. 2007), but alternative substrates have been extensively explored. Yongsmith et al. (2013) used rice, corn, mung bean, soybean, potato, sweet potato, and cassava tubers as substrates to produce exclusively yellow pigments. Bühler et al. (2015) reported the utilization of pear juice, jackfruit seeds, ethanol, fructose, maltose, sucrose, lactose, corn syrup, grape waste, cornflour, cassava starch, and glycerol as alternative substrates for pigment production of *Monascus* sp. *Monascus* FJ46 produced MFP with a lower yield of citrinin using various carbon sources, including cereals, tuber crops, and agro-industrial residues, compared with rice flour as control (Mu et al. 2015). Citrinin is a mycotoxin produced by *Monascus*

species, which has been a common problem in MFP production. Srianta et al. (2017) reported the use of rice, corn, and sorghum to produce MFP that has antioxidant activities. So, far, purple sweet potato and black rice have not been used as substrates for MFP. Thus, in this research, we proposed purple sweet potato (*Ipomoea batatas* (L.) Lam.) and black rice (*Oryza sativa* L.) as two new alternative substrates for MFP.

Purple sweet potato and black rice are considered functional foods because they are rich in anthocyanin, which also serves as their natural pigment (Ginting et al. 2015; Sompong et al. 2011). Anthocyanin is reported to have various biological activities, including strong antioxidant, anti-inflammatory, and antimicrobial properties (Khoo et al. 2017; Esatbeyoglu et al. 2017; Zhi et al. 2020). Black rice also contains active phytochemicals such as tocopherol, tocotrienols, oryzanols, vitamin B complex, and phenolic compounds (Jang et al. 2012). It also has phenolic-active ingredients four times higher than white rice (Thanuja and Parimalavalli 2020). Hence, the bioactive components in purple sweet potato and black rice make them potential substrates to increase the nutraceutical uses of MFP.

The application of MFP as a coloring additive provides additional advantages such as preservatives and food supplements (Srianta et al. 2014). The pigments produced by *Monascus* are used as food preservatives because of their antimicrobial activities. The pigments have been reported to inhibit the growth of fungi such as *Aspergillus*, *Trichoderma*, *Mucor*, *Penicillium*, and *Fusarium* and bacteria such as *Bacillus*, *Pseudomonas*, *Escherichia*, and *Streptomyces* (Ungureanu and Ferdes 2010). Rojsuntornkitti et al. (2010) noted that *Monascus* red pigment is used as a substitute for nitrite inhibited *Salmonella* spp., *Clostridium perfringens*, and *Staphylococcus aureus* in Thai sausage. *Salmonella* causes foodborne diseases because of food and water contamination. Until now, typhoid fever caused by *Salmonella typhi* is a global burden with 11.0–17.8 million typhoid fever illnesses occurring annually worldwide (Crump 2019). Recently, *S. typhi* resistances include antibiotics ampicillin, trimethoprim-sulfamethoxazole (TMP-SMX), ciprofloxacin, and ceftriaxone (Wong et al. 2019). The increasing threat of antimicrobial resistance is the reason for the search for alternative antibacterials for *S. typhi* from natural sources. Therefore, the objectives of this research were evaluating the use of purple sweet potato and black rice as new substrates for MFP production using UV-irradiated *M. purpureus* and analyzing their antibacterial activity against *S. typhi*.

MATERIALS AND METHODS

Procedures

Substrate preparation

Purple sweet potato (*Ipomoea batatas* L.) and organic black rice (*Oryza sativa* L.) Hotel® were purchased from a local market, that is, Pasar Wage, Purwokerto. Individually, purple sweet potato and black rice were prepared as described by Ginting et al. (2015), with modification. The tubers of purple sweet potatoes were thinly sliced, dried at 60°C for 32 h, ground, and then sieved with a 60 mesh to obtain a fine powder of purple sweet potato. Similarly, the black rice was thoroughly washed, dried at 60°C for 12 h, ground, and then sieved with a 60 mesh to obtain a fine powder of black rice.

Evaluation of Monascus *growth pattern*

Monascus purpureus was obtained from the Indonesian Culture Collection (InaCC) LIPI Bogor. *M. purpureus* was cultivated in potato dextrose agar (PDA) and incubated at 30°C for 7 days before being used. The growth pattern of *M. purpureus* for each substrate was evaluated based on mycelial growth. The medium used was modified from Permana et al. (2004). It consisted of fine powder of purple sweet potato or black rice (5%), KH_2PO_4 (0.25%), $NaNO_3$ (0.15%), $MgSO_4.7H_2O$ (0.1%), monosodium glutamate (0.1%), $CaCl_2$ (0.001%), and distilled water up to 100 mL. The pH was adjusted to 6.0, and the medium was sterilized at 121°C for 15 min. After cooling, the medium was inoculated with *M. purpureus* and incubated at 30°C. The mycelial growth was measured as dry weight every day for 7 days. The incubation time with the highest mycelial weight was used for inoculum preparation.

UV irradiation and inoculum preparation

M. purpureus was inoculated with PDA in a Petri dish. Aseptically, the Petri disk cover was opened, and the culture was irradiated with ultraviolet light at λ254 nm with exposure times of 0, 2, 3, and 4 min. The control was *M. purpureus* without UV irradiation (0 min). All irradiated *M. purpureus* samples were then incubated at 30°C for 7 days. The sterilized medium, as described earlier, was inoculated with irradiated *M. purpureus* and incubated at 30°C for 4 days to produce an inoculum.

Solid-state fermentation

Solid-state fermentation was performed using Completely Randomized Factorial Design with three factorials. The first factor was two types of substrate (S1 = purple sweet potato and S2 = black rice), the second factor was four lengths of UV irradiation at λ254 nm (R0 = 0 min, R1 = 2 min, R2 = 3 min, and R3 = 4 min), and the third factor was three incubation times (T1 = 7 days, T2 = 14 days, and T3 = 21 days). The choice of incubation times followed Yongsmith et al. (2013) with modification. Each treatment was repeated two times, so there were 48 experimental units. The parameters measured were the yield of the *Monascus* fermented products (MFPs) and the absorbance of the ethanol extracts of MFP at λ390 and λ500 nm for pigment evaluation.

100 g of purple sweet potato (S1) or black rice powder (S2) was sterilized at 121°C for 15 min. After cooling, each substrate was inoculated with 2% inoculum. The mixture was stirred aseptically and then closed tightly with sterilized parchment paper. The mixture was incubated at 30°C with three incubation times (T1, T2, and T3). After each incubation time, all MFPs were dried in an oven at

60°C to yield irradiated MFP types, which were MFP–purple sweet potato and MFP–black rice.

0.05 g of MFP products were extracted with 10 mL of 95% ethanol. The mixture was centrifuged, and the filtrate obtained was measured with UV–Vis spectrophotometry at λ390 nm for the yellow pigment and λ500 nm for the red pigment (Kasim et al. 2005). The MFP product with the highest absorbance was evaluated for antibacterial activity against *Salmonella typhi*.

Evaluation of antibacterial activity

The MFP product with the highest absorbance was extracted with 95% ethanol with a ratio of 1:5 (w/v) by maceration. After 3 × 24 h of macerations, each mixture was filtered, and the filtrate obtained was evaporated to give the ethanol extract. The antibacterial activity of the ethanol extract against *Salmonella typhi* was evaluated by disk diffusion or Kirby–Bauer method (Hudzicki 2009). *S. typhi* was from the Microbiology Laboratory, Faculty of Biology, Universitas Jenderal Soedirman, Purwokerto. *S. typhi* on nutrient agar slant was serially diluted with sterile 0.9% NaCl into 10^{-5} dilution. 100 µL of 10^{-5} suspension of S. *typhi* was uniformly spread over the NA medium and incubated 37°C overnight. Paper disks (ø 6 mm, thickness of 0.5 mm) were impregnated with 15 µL of four concentrations (0.05, 0.10, 0.15, and 0.20 g/mL) of ethanol extracts. Then, each disk was put on NA plates inoculated with *S. typhi* and incubated at 37°C for 24 h. The positive control was 5% (w/v) of chloramphenicol, and the negative one was a sterile aqueous solution. The inhibition zone of each extract was calculated based on the diameter inhibition zone minus the diameter of the paper disk used.

Analysis of ethanol extract

The ethanol extract with the highest antibacterial activity was analyzed using thin-layer chromatography (TLC), followed by bioautography. The ethanol extract was spotted on the TLC sheet (Silica gel 60–F254 nm) and eluted with n-butanol: acetic acid: water (5:1:4). After elution, each TLC was sprayed with the following reagents: 1% ethanolic solution of $AlCl_3$ for flavonoid, *p*-anisaldehyde–sulfuric acid for terpenoid, 1% $FeCl_3$ for tannin, Dragendorff reagent for alkaloid, and Liebermann–Burchard reagent for saponins. All TLCs were observed under UV light at λ365 nm for color changes, and its R_f value was calculated (Waldi 1965). Each separated spot from TLC was carefully scraped with a sterile spatula and then impregnated directly on the NA inoculated with *S. typhi* for bioautography analysis. The plates were incubated at 37°C for 24 h. The inhibition zone observed was calculated and compared to the TLC results (Nostro et al. 2000).

Data analysis

The data from solid-state fermentation were analyzed using analysis of variance. The results that showed significant diversity were further analyzed using Duncan's multiple range test (DMRT) with a 95% confidence level ($\alpha = 0.05$). The lowest concentration of ethanol extracts capable of inhibiting *S. typhi* was considered the minimum inhibitory concentration (MIC).

RESULTS AND DISCUSSION

The morphology of *M. purpureus*

The morphology development of *M. purpureus* cultivated on PDA was observed for 7 days at 27°C–32°C. The culture rapidly grew and spread on the surface of the media. The colony has a diameter of 20–30 mm, the texture was wooly, and the surface was *flocculent superficial*. In the early stage, the color of the mycelium was white. It rapidly turned into pink, subsequently into yellow-orange, and finally became crimson red as the colony ages (Figure 1). The red pigment was observed both in the mycelium and diffused pigment in the media.

Monascus purpureus showed different growth characteristics because of UV irradiation at λ254 nm. The colony changed in size, shape, and color of the mycelium. The colony's size was reduced to 2–6 mm in diameter, the shape became round, and the color of the mycelium was white to reddish-orange (Figure 2). The growth of *M. purpureus* after 2 min of UV irradiation was better compared to others.

Analysis of growth pattern

The growth of *M. purpureus* in liquid medium was evaluated as the increment in mycelium weight (g) during incubation time (d). The research results showed that the growth curve of *M. purpureus* on both purple sweet potato and black rice substrates followed the growth pattern of fungi in general. *M. purpureus* grew quickly up to the fourth day of cultivation and slowed down after that. The highest mycelium weight (1.86 g) using purple sweet potato substrate was achieved on the fourth day, and the black rice substrate has the highest mycelium weight (2.32 g) after the fourth day of incubation. Thus, the inoculum of *M. purpureus* was prepared by the cultivation of spores in a liquid medium for 4 days. Mycelium weight clearly indicated that the growth of *M. purpureus* was better in black rice than in purple sweet potato as a substrate (Figure 3). Besides, purple sweet potato formed sticky clumps, which might hamper the dispersal of oxygen and nutrients for the effective growth of *M. purpureus*.

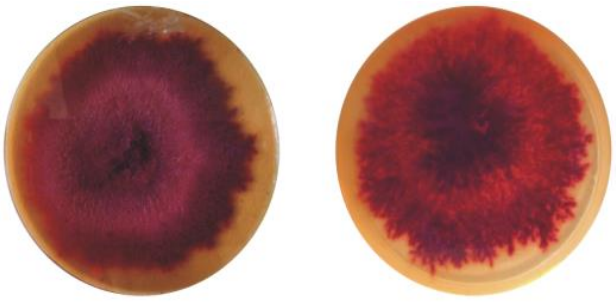

Figure 1. The colony of *M. purpureus*. A. View from the top, B. View from the bottom

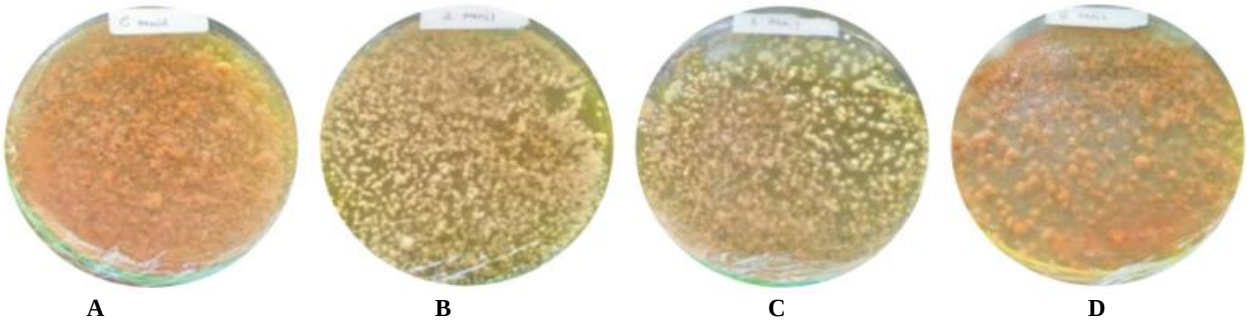

Figure 2. The colony of *M. purpureus* after UV irradiation for: A. 0, B. 2, C. 3, D. 4 min

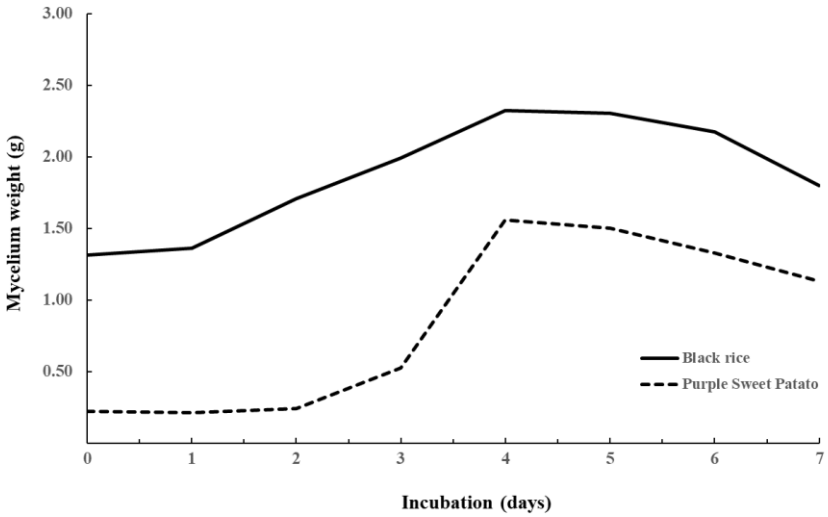

Figure 3. The growth curve of *M. purpureus* on purple sweet potato and black rice substrates

Monascus fermented product (MFP)

Fermentation processes were conducted for 21 days with an interval of 7 days. MFP–purple sweet potato was sticky solid and reddish-black, had a sweet odor, and caramelized, whereas MFP–black rice was sticky and reddish-black and had a grainy form. The yield of MFP–purple sweet potato varied from 5.97% to 26.48%. The highest yield (26.48%) was obtained from fermentation with UV-irradiated *M. purpureus* for 3 min and incubation for 21 days. The yield of MFP–black rice varied from 42.47% to 51.88%. The highest yield (51.88%) was obtained with UV-irradiated *M. purpureus* for 2 min and incubation for 21 d. The overall results indicated that MFP–black rice had a higher yield than MFP–purple sweet potato (Figure 4).

The absorbance values of the ethanol extract from MFP–purple sweet potato and MFP–black rice are shown in Table 1 and Table 2, respectively. The fermentation process with a longer incubation time produced a higher absorbance value. These results applied for both MFP–purple sweet potato and MFP–black rice. The absorbance of the yellow pigment at λ 390 nm was varied from 0.17 ± 0.01 to 3.90 ± 0.12, whereas the absorbance of the red pigment at λ 500 nm was varied from 0.03 ± 0.00 to 3.98 ± 0.02. The highest absorbance of both pigments in MFP–purple sweet potato was obtained from UV-irradiated *M. purpureus* for 3 min (MFP3–purple sweet potato), whereas that in MFP–black rice was obtained from UV-irradiated *M. purpureus* for 2 min (MFP2–black rice). Both fermentations occurred in 21 days. The result of the variance analysis showed that the interaction of substrates, length of UV irradiation, and incubation time were significantly different at a 95% confidence level ($p > 0.05$). This result indicated that the type of substrate, length of UV irradiation, and fermentation time affect MFP production.

Antibacterial activity of ethanol extracts

Ethanol extracts from both MFP3–purple sweet potato and MFP2–black rice showed antibacterial activity toward *S. typhi* with inhibition zones of 1.0 and 1.5 mm, respectively. The minimum inhibition concentrations (MICs) of ethanol extracts were 0.2 g/L for MFP3–purple sweet potato and 0.15 g/mL for MFP2–black rice. This finding suggested the possible use of MFP3–purple sweet potato and MFP2–black rice as functional food ingredients not only for food colorants but also for the prevention of *S. typhi* infection. The T-test analysis result at a 95% confidence level indicated the difference in the antibacterial activities of MFP3–purple sweet potato and MFP2–black rice to *S. typhi*. Correlation test (r) between concentrations of fermented substrates showed that MFP2–black rice had a better antibacterial activity to *S. typhi* than MFP3–purple sweet potato.

Since MFP2–black rice has the highest antibacterial activity, its ethanol extract was used for TLC and bioautography. The TLC results gave three spots with R_f values of 0.23, 0.85, and 0.96. The results from spray reagents indicated the presence of saponin (first spot), flavonoid (second spot), and an alkaloid (third spot) compounds. Each spot was scraped carefully and subjected to media inoculated with *S. typhi* for bioautography analysis using an aqueous solution as the negative control. After incubation, the first and second spots showed inhibition against *S. typhi* growth, with inhibition zones of 14.7 and 19.0 mm, respectively (Figure 5). These results suggested that MFP2–black rice contained saponin and flavonoid, which have antibacterial activity toward *S. typhi*.

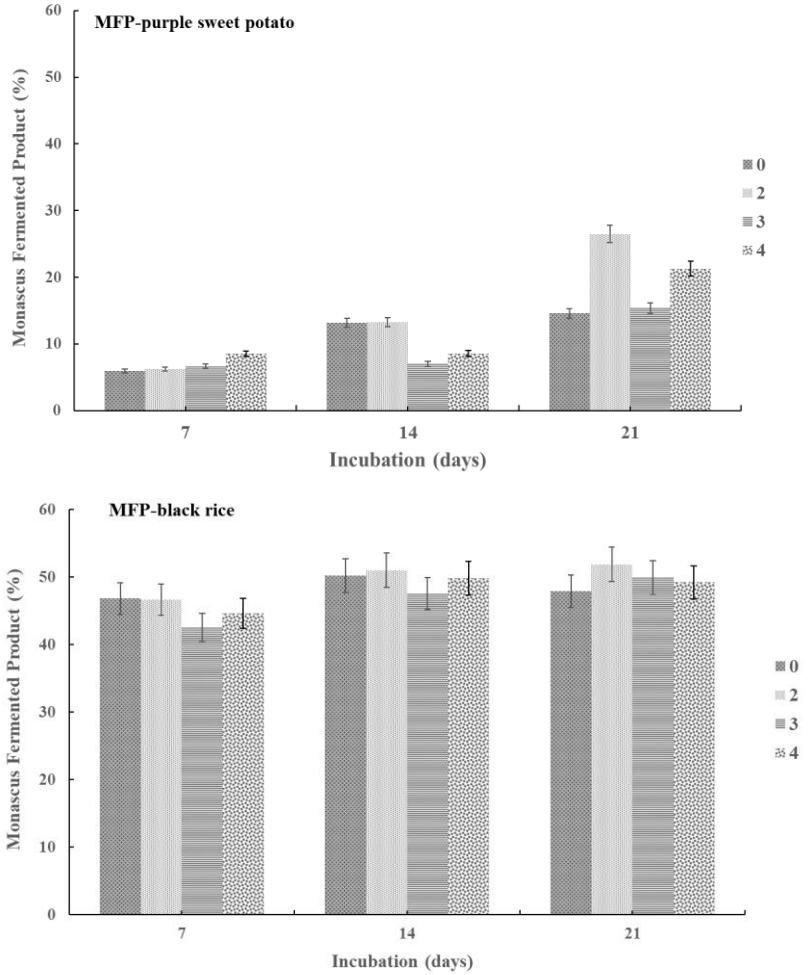

Figure 4. *Monascus* fermented product from purple sweet potato and black rice substrates

Table 1. The absorbance of ethanol extracts from MFP–purple sweet potato

Sample	Absorbance λ_{390nm}			Absorbance λ_{500nm}		
	7 days	14 days	21 days	7 days	14 days	21 days
0 min	0.30 ± 0.20	0.78 ± 0.00	3.59 ± 0.08	0.12 ± 0.05	0.53 ± 0.00	2.26 ± 0.01
2 min	0.42 ± 0.00	1.78 ± 0.00	3.78 ± 0.26	0.19 ± 0.00	1.52 ± 0.00	3.22 ± 0.01
3 min	0.17 ± 0.01	0.82 ± 0.00	3.90 ± 0.12	0.03 ± 0.00	0.56 ± 0.00	3.98 ± 0.03
4 min	0.08 ± 0.05	0.53 ± 0.00	2.37 ± 0.00	0.03 ± 0.00	0.30 ± 0.00	1.55 ± 0.01

Table 2. The absorbance of ethanol extracts from MFP–black rice

Sample	Absorbance λ_{390nm}			Absorbance λ_{500nm}		
	7 days	14 days	21 days	7 days	14 days	21 days
0 min	0.87 ± 0.01	0.43 ± 0.00	3.65 ± 0.25	0.55 ± 0.01	0.28 ± 0.01	3.60 ± 0.00
2 min	0.78 ± 0.00	2.78 ± 0.02	3.85 ± 0.17	0.45 ± 0.00	2.05 ± 0.00	3.98 ± 0.02
3 min	0.74 ± 0.01	2.36 ± 0.01	3.74 ± 0.30	0.44 ± 0.00	2.09 ± 0.01	3.48 ± 0.01
4 min	1.06 ± 0.01	1.20 ± 0.01	3.83 ± 0.06	0.67 ± 0.00	1.13 ± 0.00	3.60 ± 0.00

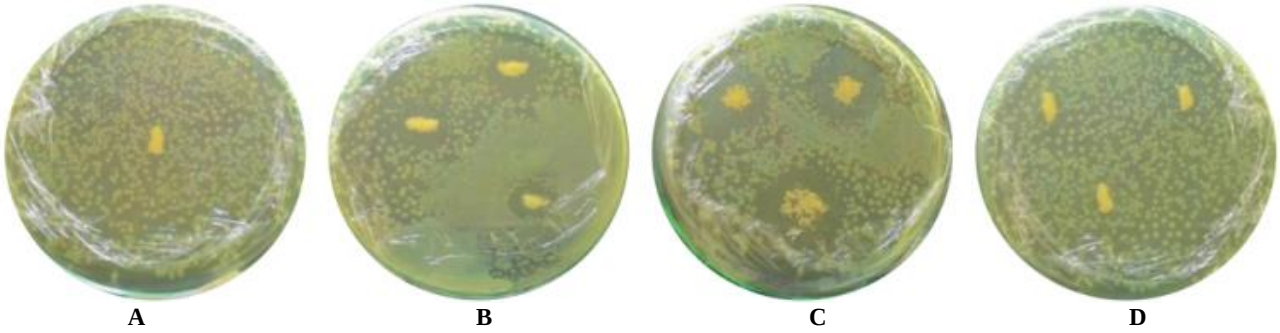

Figure 5. Bioautography results of three TLC spots from the ethanol extract of MFP2–black rice. A. The negative control, B. First spot, C. Second spot, D. Third spot

Discussion

The growth of *M. purpureus* was affected by UV irradiation. Bühler et al. (2015) stated that the average radial growth of *M. purpureus* was between 2.3 and 3.1 mm. He observed a decrease in the radial growth rate of *Monascus ruber* exposed to direct illumination. The radial growth rate was 1.50 mm in darkness, whereas it was reduced to 0.59 mm with direct illumination.

Various preparations of inoculum have been reported. Inoculum for lovastatin production was prepared with the inoculation of *M. purpureus* spore in rice substrate and incubated for 14 days (Kasim et al. 2005). Inoculum from various cereals, tuber crops, and agro-industrial residues was prepared by cultivating the spore of *Monascus* strain FJ46 for 24 h in a rotary shaker incubator (Mu et al. 2015). The inoculum of *M. ruber* CCT3802 was obtained by the germination of *M. ruber* spores for 60 h (Bühler et al. 2015). *M. purpureus* starter for MFP with antioxidant activity was prepared by inoculating *M. purpureus* M9 and incubated for 7 days (Srianta et al. 2017). The inoculum preparation varies, possibly because of the different intended utilization.

MFP–purple sweet potato gave lower yields than MFP–black rice. The difference in yield might be due to the variation in carbohydrate content. Black rice contains 74.09% to 75.71% of total carbohydrates (Sompong et al. 2011), whereas the purple sweet potato contains 22.64% of carbohydrates (Ginting et al. 2015). During fermentation, *M. purpureus* consumes starchy substrates as a source of energy for the growth and developmental needs of secondary metabolites. It produces glucoamylase and α-amylase enzymes, the key enzymes for starch hydrolysis (Yoshizaki et al. 2010). Thus, the difference in carbohydrate content apparently results in a different fermentation product yield.

Monascus produces pigments at various incubation times. *M. purpureus* M9 produced MFP with antioxidant activity after 14 days of incubation (Srianta et al. 2017). Mutant *Monascus* sp. TISTR 3179 rapidly produced yellow pigments after 5 days of cultivation using rice, corn, mung bean, soybean, potato, sweet potato, and cassava tubers as substrates (Yongsmith et al. 2013). Huang et al. (2019) observed that the cell growth of mutant *Monascus U-2* increased rapidly and reached its maximum at the 10^{th}–11^{th} day of incubation. During the exponential phase of cell growth, monacolin K was produced and reached its maximum during the 17^{th}–18^{th} day of incubation. These observations indicated that *Monascus* produced secondary metabolites during the stationary phase of cell growth. However, a shorter incubation time for monacolin K production was reported by Sun et al. (2011). Monacolin K level reached the highest on day 13 when *Sporobolomyces huaxiensis* was introduced as a fungal elicitor in the fermentation system.

In this research, *M. purpureus* converted the substrate into primary metabolite products for cell growth and had sufficient time to form pigments as secondary metabolites during stationary phases from 7 to 21 days of incubation. UV irradiation toward *M. purpureus* increased the intensity of the pigment until it reached a certain exposure time. Longer exposure to UV irradiation decreased the intensity of pigments, which might alter the microbial ability to produce pigments. MFPs with the highest absorbance values, which were MFP3–purple sweet potato and MFP2–black rice, were further analyzed for antibacterial activity.

Monascus pigments produced by *M. ruber* CCT 3802, *M. purpureus*, *M. purpureus* N11S, and *Monascus* M3428 showed antimicrobial activity against *Escherichia coli*, *Salmonella enteritidis*, *B. subtilis*, S. aureus, and yeast, respectively. These antimicrobial activities of *Monascus* pigments indicate their potential as food preservatives (Kim and Ku 2018). Christiana (2016) mentioned that the antimicrobial activities of *Monascus* pigments vary with the type of pigment. Ungureanu and Ferdes (2010) reported that the red pigment from red yeast rice inhibited the growth of *Bacillus subtilis*, *Pseudomonas aeruginosa*, and *Streptomyces albus.* The bacteriostatic effects suggested the preservative value of the *Monascus* pigment. Rojsuntornkitti et al. (2010) used *M. purpureus* TISTR 3080 to produce Chinese red broken rice with antibacterial activity against *C. perfringens*, *Salmonella* spp., and *S. aureus*. The yellow pigment produced by mutant *Monascus* sp. TISTR 3642 was useful for the protection of food products, such as fresh Chinese noodles, or non-food products, such as cosmetics (Yongsmith et al. 2013).

Purple sweet potato and black rice served as potential substrates for MFP using UV-irradiated *M. purpureus* for 3 and 2 min, respectively. Solid-state fermentation was

carried out for 21 days to obtain the highest yield. The ethanol extracts from both MFP–purple sweet potato and MFP–black rice showed antibacterial activities against *S. typhi*. Further studies on the elucidation of the bioactive compounds from MFP–purple sweet potato and MFP–black rice will be considered for a better understanding of their pharmaceutical benefits.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the Head of the Bureau of Planning and Foreign Cooperation under the Ministry of Education and Culture of Republic Indonesia for the Excellent Scholarship. All authors have read and approved the final manuscript. The authors declare that there are no conflicts of interest.

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Gmail Klinik Jurnal CAPA <clinicaljournalcapa@gmail.com>

Fwd: [biodiv] Submission Acknowledgement

1 message

Ari Asnani <asnania217@gmail.com> 15 February 2021 at 21:18
To: clinicaljournalcapa@gmail.com

CJ2086

---------- Forwarded message ---------
From: **Ahmad Dwi Setyawan** <smujo.id@gmail.com>
Date: Wed, Dec 2, 2020 at 4:37 PM
Subject: [biodiv] Submission Acknowledgement
To: ARI ASNANI <asnania217@gmail.com>

ARI ASNANI:

Thank you for submitting the manuscript, "The characteristics of fermented purple sweet potato (Ipomoea batatas L.) And Black Rice (Oryza sativa L.) using UV-irradiated Monascus purpureus" to Biodiversitas Journal of Biological Diversity. With the online journal management system that we are using, you will be able to track its progress through the editorial process by logging in to the journal web site:

Submission URL: https://smujo.id/biodiv/authorDashboard/submission/7309
Username: dr_asnani

If you have any questions, please contact me. Thank you for considering this journal as a venue for your work.

Ahmad Dwi Setyawan

_____
Biodiversitas Journal of Biological Diversity

Gmail Klinik Jurnal CAPA <clinicaljournalcapa@gmail.com>

Fwd: [biodiv] Editor Decision

1 message

Ari Asnani <asnania217@gmail.com> 15 February 2021 at 21:18
To: clinicaljournalcapa@gmail.com

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From: **Smujo Editors** <smujo.id@gmail.com>
Date: Sun, Dec 27, 2020 at 7:16 AM
Subject: [biodiv] Editor Decision
To: ISWIYANTI NOVITA <novitaiswiyanti@gmail.com>, OEDJIJONO <oedjijono@gmail.com>, ARI ASNANI <asnania217@gmail.com>

ISWIYANTI NOVITA, OEDJIJONO, ARI ASNANI:

We have reached a decision regarding your submission to Biodiversitas Journal of Biological Diversity, "The characteristics of fermented purple sweet potato (Ipomoea batatas L.) And Black Rice (Oryza sativa L.) using UV-irradiated Monascus purpureus".

Our decision is: Revisions Required

Smujo Editors
editors@smujo.id

Reviewer E:

Line 73. Could you please avoid using objectives and aim in the same sentence.

Line 103. Why did the authors choose to use a 21 days fermentation?

Recommendation: Revisions Required

Biodiversitas Journal of Biological Diversity

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Gmail Klinik Jurnal CAPA <clinicaljournalcapa@gmail.com>

Fwd: [biodiv] Editor Decision

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Ari Asnani <asnania217@gmail.com> 15 February 2021 at 21:19
To: clinicaljournalcapa@gmail.com

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From: **Smujo Editors** <smujo.id@gmail.com>
Date: Thu, Jan 14, 2021 at 3:08 PM
Subject: [biodiv] Editor Decision
To: ISWIYANTI NOVITA <novitaiswiyanti@gmail.com>, OEDJIJONO <oedjijono@gmail.com>, ARI ASNANI <asnania217@gmail.com>

ISWIYANTI NOVITA, OEDJIJONO, ARI ASNANI:

We have reached a decision regarding your submission to Biodiversitas Journal of Biological Diversity, "The characteristics of fermented purple sweet potato (Ipomoea batatas) and black rice (Oryza sativa) using UV-irradiated Monascus purpureus ".

Our decision is to: Accept Submission

Smujo Editors
editors@smujo.id

Biodiversitas Journal of Biological Diversity

Gmail Klinik Jurnal CAPA <clinicaljournalcapa@gmail.com>

Fwd: [biodiv] Editor Decision

1 message

Ari Asnani <asnania217@gmail.com> 15 February 2021 at 21:19
To: clinicaljournalcapa@gmail.com

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---------- Forwarded message ---------
From: **Smujo Editors** <smujo.id@gmail.com>
Date: Tue, Jan 19, 2021 at 1:33 PM
Subject: [biodiv] Editor Decision
To: ISWIYANTI NOVITA <novitaiswiyanti@gmail.com>, OEDJIJONO <oedjijono@gmail.com>, ARI ASNANI <asnania217@gmail.com>

ISWIYANTI NOVITA, OEDJIJONO, ARI ASNANI:

The editing of your submission, "The characteristics of fermented purple sweet potato (Ipomoea batatas) and black rice (Oryza sativa) using UV-irradiated Monascus purpureus ," is complete. We are now sending it to production.

Submission URL: https://smujo.id/biodiv/authorDashboard/submission/7309

Smujo Editors
editors@smujo.id

_____
Biodiversitas Journal of Biological Diversity