

## *Aspergillus* sp. For Indigosol Blue and Remazol Brilliant Blue R Decolorization

Fitria Ayudi Ulfimaturahmah<sup>1</sup>, Ratna Stia Dewi<sup>2</sup>, Ajeng Arum Sari<sup>3</sup>

<sup>1,2</sup>Fakultas Biologi, Universitas Jenderal Soedirman  
Jalan dr Suparno 63 Purwokerto 53122

<sup>3</sup>Pusat Penelitian Kimia, LIPI  
email: [ratna.dewi0509@unsoed.ac.id](mailto:ratna.dewi0509@unsoed.ac.id)

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### Abstract

Synthetic dyes are artificial dyes manufactured by Industry and commonly used for the textile industry. These dyes had potentially caused an environmental problem. Many types of dyes are recalcitrant and have toxic properties for living organisms. It can be removed by decolorization method, especially a biological decolorization by fungi. Fungi were chosen due to the ability to degrade toxic components. *Aspergillus* sp. is the fungi which commonly used for dye decolorization. It might be caused that *Aspergillus* sp. is one type of fungi lived in the textile waste and expected not to die in the dye decolorization treatment. The purpose of this research was to investigate the ability of the mycelia pellets of *Aspergillus* sp to decolorized Indigosol Blue dye and Remazol Brilliant Blue R (RBBR) dye. This research showed that mycelial pellets of *Aspergillus* sp. had high activity of decolorization of Indigosol Blue dye up to 85.37% and RBBR dye up to 80.21% and caused low pH value after 24 hour incubation time compared to the control solution.

Keywords: *Aspergillus* sp., decolorization, pH.

### INTRODUCTION

Synthetic dyes are artificial dyes manufactured by the manufacturing industry. These dyes are commonly used for the textile industry. It also potentially caused an environmental problem. The dye pollutant in water releases products that are toxic, mutagenic, and carcinogenic to the living organisms so that it creates a hazardous problem (Bassyouni *et al.*, 2017). The example of synthetic dyes is Remazol Brilliant Blue R (RBBR) and Indigosol Blue. Both of them are anthraquinone dyes and difficult to degraded. Dye compounds can be decolorized by physical and chemical methods, however, it required high costs and produced dangerous compounds (Awaluddin *et al.* 2001). The biological method used as an alternative method because it is cheap and environmentally friendly (Dewi & Lestari 2010).

*Aspergillus* sp. is one type of fungi found in textile waste and can be used as a dye decolorization agent. Hefnawy *et al.* (2017) reported the fungi decolorization of dye could be achieved by treating with *Aspergillus flavus* and *Aspergillus niger*. This research used isolates of *Aspergillus* sp. 2 as collection from Dewi *et al.* (2018a,b, 2019). They reported that *Aspergillus* sp. 2 has characteristic as yellow-green colony color, white mycelium color, and also has a vesicle, metullae, phialides, and foot cells. The fungal degradation products did not cause any toxicity in plants. *Aspergillus* is known to be very effective in decolorizing various types of dyes even compared to other microfungi. *Aspergillus* sp. was very effective in the removal of biochemical oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solids (TDS), total suspended solids (TSS), and electrical conductance (EC). Dewi &

Lestari (2010) reported that genus *Aspergillus* sp. is fungi which has a better ability than *Fusarium* sp. to decolorize handmade batik wastewater.

The problem of this research was how the ability of mycelia pellets of *Aspergillus* sp. to decolorized the dyes. The purpose of this research was to investigate the ability of the mycelia pellets of *Aspergillus* sp. on dyes decolorization.

## MATERIAL AND METHODS

The material used in this research was isolate of *Aspergillus* sp. (Dewi *et al.*, 2018a,b). The tools used in this research are rotary shaker, spectrophotometry, pH meter, sterile blender, laminar airflow (LAF), and autoclave.

### Test solution preparation

The test solution also prepared and consisted of 90 mL Malt Extract (ME) medium and 10 mL dye solution (Zhang & Yu, 2000). The test solution was contained as 100 ppm dye solution.

### Adsorbent preparation (Zhang & Yu, 2000).

The fungi cultures are inoculated on ME medium and cultivated on the rotary shake bath 100 rpm for five days. Then, mycelia pellets were homogenized aseptically by using the sterilized blender. Five millilitres inoculum continued to inoculate on ME medium. Then, Erlenmeyer flask

was incubated on rotary shaker 100 rpm for four days. Mycelia pellets were formed, harvested, and used as 5 g wet pellets in 100 mL test solution.

### Treatments preparation.

The sampling was carried out for 24 hours. Then, the samples were analyzed for dye decolorization test and pH measurement.

### Dye decolorization

The samples were analyzed by UV-vis spectrophotometry. The percentage of decolorization was analyzed by the formula:

$$\% \text{ Dec.} = \frac{\text{first absorbance} - \text{last absorbance}}{\text{first absorbance}} \times 100\%$$

Note.

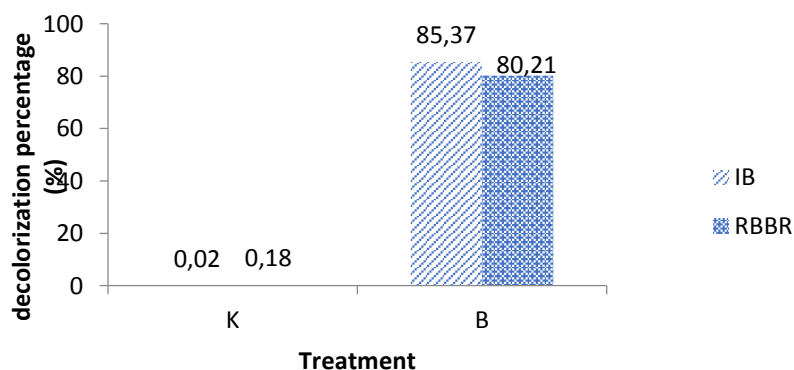
Dec. = decolorization

### pH measurement

The samples were taken from the Erlenmeyer flask. The pH was measured on the control solution and the dyes solution after 24 hour incubation time.

## RESULT AND DISCUSSION

The decolorization assay has been carried out on the RBBR dye and Indigosol Blue dye by using mycelial pellets of *Aspergillus* sp. The initial dye concentration on the test solution was 100 ppm. The decolorization percentage of Indigosol Blue dye and RBBR dye was shown in Figure 1.



**Figure 1.** Histogram of decolorization percentage of Indigosol Blue dye and RBBR dye using *Aspergillus* sp. mycelia pellets.

Note:

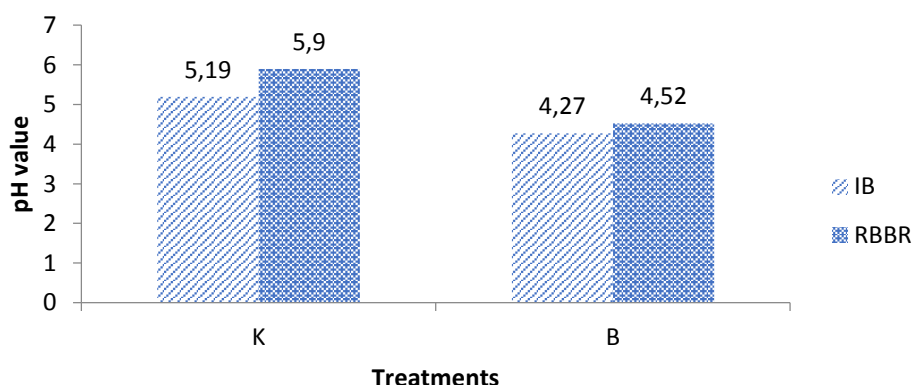
K = Control

B = mycelia pellets

The result showed that the decolorization percentage of adsorbent B on Indigosol Blue dye was 85.37%, while RBBR dye was 80.21%. Then, the control solution on Indigosol Blue dye has 0.02% and RBBR has 0.18%. This result was indicted that the mycelial pellets of *Aspergillus* sp. have the ability to decolorized the dyes. *Aspergillus* sp. used in this research has morphological characters as dark green colony color, reverse colony color is yellowish to brown, has spores, powdery surface, concentric distribution, and microfungi. According to Dewi *et al.* (2018a,b), *Aspergillus* sp. has characteristics as yellow-green colony color, white mycelium color, spore diameter as 50µm, and also has vesicle, metullae, phialides, and foot cells. This fungus was a collection from Dewi *et al.* (2018a,b) as indigenous fungi isolated from dye effluent. The type of indigenous fungi was used as a dye decolorization agent. Beside

expected to have resistance to conditions below normal, it also can degrade dyes. Singh *et al.* (2018) also reported that *Aspergillus* sp. isolated from the sludge of textile industry can grow in the presence of dye and was effective in removing dye. The growth of indigenous isolate from sludge textile was efficient to decolorized the dye solutions at higher concentrations. Przystas *et al.* (2018) also reported that decolorization effectiveness depended on the strain used in the process. It was demonstrated that strains isolated from polluted sites had a greater decolorization potential than others.

The pH was measured on the control solution and Indigosol Blue dye and RBBR dye solution with mycelia pellets of *Aspergillus* sp. The pH of both of the dyes has a lower value than the control solution (Figure 2).



**Figure 2.** pH Analysis of Indigosol Blue dye and RBBR dye at 24 hour with Mycelia pellets of *Aspergillus* sp.

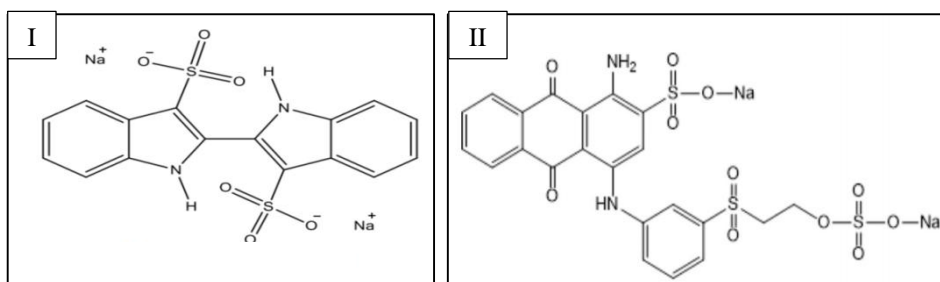
Note:  
K = Control  
B = mycelia pellets

The result showed that the pH of mycelia pellets of *Aspergillus* sp. on Indigosol Blue dye was 4.27, while RBBR dye was 4.52. Then, the pH of control on Indigosol Blue dye was 5.19, while RBBR dye was 5.9. It means that the mycelia pellets of *Aspergillus* sp. had the ability to decolorize the dye indicated by decreasing pH. This is similar to Hadianito (2000), in the decreasing of

acidic pH conditions, the absorbance value decreases so that the percentage of decolorization is greater. Kunjadia *et al.* (2016) reported that the effect of initial pH on dye decolorization by fungi varied depending on the type of the dye. Yucel (2018) reported the dye decolorization rate increases up to almost 70% in the pH range 3-4 and decreased with the increasing pH value.

Based on the result, it can be known that mycelia pellets of *Aspergillus sp.* has the ability to decolorized the dye, which indicated by decreasing absorbance value. In addition, mycelial pellets of *Aspergillus sp.* showed the decreasing pH to an acidic condition which correspondingly to the decreasing of absorbance value. The result showed that Indigosol Blue dye has a higher decolorization percentage compared to RBBR dye. Correspondingly, the pH of Indigosol dye after

decolorization process was lower than RBBR dye. It might be indicated that the Indigosol Blue dye was easier to decolorized than RBBR dye. RBBR dye has a chemical formula  $C_{22}H_{16}N_2Na_2O_{11}S_3$  (Ahmad *et al.*, 2011). Steingruber (2004) also reported that the chemical formula of Indigosol dye is  $C_{16}H_{10}N_2O_2$ . It is indicated that Indigosol Blue dye had a total of 16 Carbon, 10 Hydrogen, and 2 Oxygen. Besides, RBBR had a total of 22 Carbon, 16 Hydrogen, and 11 Oxygen.



**Figure 3.** (I) The chemical chain of Indigosol blue dyes (Aryanti *et al.*, 2017); (II) The chemical chain of Remazol Brilliant Blue R dye (Torgut *et al.*, 2017).

Indigosol dye is a reactive synthetic dye commonly used as a fabric dye and widely used to produce light and bright colors (Aryanti *et al.*, 2017). Indigosol Blue is one of the anthraquinone synthetic dyes (Herfiani *et al.*, 2017). RBBR (Figure 3) is an anthraquinone dye which is one of the chromophoric groups (Rahmat *et al.*, 2016). RBBR was widely used in the textile industry due to its favourable characteristics such as low energy consumption, simple application techniques and not readily biodegradable (Ahmad & Alrozi, 2011).

## CONCLUSION

*Aspergillus sp.* has the ability to decolorize the Indigosol Blue dye up to 85.37% and RBBR dye up to 80.21%. It was indicated by high decolorization percentage and lower pH value after 24 hours incubation compared to the control solution. Then, the result also showed that Indigosol Blue dye was easier to decolorized than RBBR dye.

## REFERENCES

- Ahmad, M. A., & Alrozi, R., 2011. Optimization of Rambutan Peel Based Activated Carbon Preparation Conditions for Remazol Brilliant Blue R Removal. *Chemical Engineering Journal*, 168(1) : 280–5.
- Ahmad, M. A., Yun, E. T. C., Abustan, I., Ahmad, N., & Sulaiman, S. K., 2011. Optimization of Preparation Conditions for Corn Cob Based Activated Carbons for the Removal of Remazol Brilliant Blue R dye. *International Journal of Engineering & Technology*, 11(1) : 216-221.
- Aryanti, N., Sandria, F. K. I., Putriadi, R. H., & Wardhani, D. H., 2017. Evaluation of Micellar-Enhanced Ultrafiltration (MEUF) Membrane for Dye Removal of Synthetic Remazol Dye Wastewater. *Engineering Journal*, 21(3) : 23-35.
- Awaluddin, R., Darah, S., Ibrahim, C. D. & Uyub, A. M., 2001. *Decolorization of Commercially Available Synthetic Dyes by The White Rot Fungus Phanerochaete chrysosporium ME 446 (ATCC 34541)*. Kuala Lumpur, Proceedings of NSF Workshop.
- Bassyouni, D. G., Hamad, H. A., El-Ashtoukhy, E-S. Z., Amin, N. K., and Abd-El Latif, M. M., 2017. Comparative performance of

- anodic oxidation and electrocoagulation as clean processes for electrocatalytic degradation of diazo dye Acid Brown 14 in aqueous medium. *Journal of Hazardous Material*, 335 : 178-187.
- Dewi, R. S., & Lestari, S., 2010. Dekolorisasi Limbah Batik Tulis Menggunakan Jamur Indigenous Hasil Isolasi pada Konsentrasi Limbah yang Berbeda. *Molekul*, 5(2) : 75-82.
- Dewi, R. S., Kasiamdari, R. S., Martani, E. & Purwestry, Y. A., 2018a. Bioremediation of Indiosol Blue-04B Batik effluent by Indienous Fungal Isolates, *Aspergillus* spp. *Omni Akuatika*, 14(2) : 11-20.
- Dewi, R. S., Kasiamdari, R. S., Martani, E. & Purwestry, Y. A., 2018b. Decolorization and detoxification of batik dye effluent containing Indigosol Blue-04B using fungi isolated from contaminated dye effluent. *Indonesian Journal of Biotechnology*, 23(2) : 54-60.
- Dewi, R. S., Kasiamdari, R. S., Martani, E. & Purwestry, Y. A., 2019. Optimization of The Conditions for The Decolorization of Batik Wastewater by *Aspergillus* sp. 3. AIP Conference Proceedings. Hlm. 1-9. [online] <https://aip.scitation.org/doi/abs/10.1063/1.5097505> [Diakses 28 Agustus 2019].
- Hadianto A. D., 2000. Pengaruh TA dan Penambahan H<sub>2</sub>O<sub>2</sub> Terhadap Elektrokolorisasi Pewarna Indigo [skripsi]. Universitas Diponegoro Semarang.
- Hefnawy, M. A., Gharieb, M. M., Shaaban, M. T. & Soliman, A. M., 2017. Optimization of Culture Condition for Enhanced Decolorization of Direct blue Dye by *Aspergillus flavus* and *Penicillium canescens*. *Journal of Applied Pharmaceutical Science*, 7(2) : 83-92,
- Herfiani, Z. H., Rezagama, A., & Nur, M. 2017. Pengolahan limbah cair zat warna jenis indigosol blue (C.i Vat Blue 4) sebagai hasil produksi kain batik menggunakan metode ozonasi dan aadsorpsi arang aktif batok kelapa terhadap parameter cod dan warna. *Jurnal Teknik Lingkungan*, 6 (3): 1-10.
- Kunjadia, P. D., Sanghvi, G. V., Kunjadia, A. P., Mukhopadhyay, P. N., & Dave, G. S., 2016. Role of ligninolytic enzymes of white rot fungi (*Pleurotus* spp.) grown with azo dyes. *Springerplus*, 5 : 1487-1495.
- Przystas, W., Zabłocka-Godlewska, E., & Grabinska-Sota, E., 2018. Efficiency of Decolorization of Different Dyes using Fungal Biomass Immobilized on Different Solid Supports. *Brazilian Journal of Microbiology*, 49(2) : 285-295.
- Rahmat, N. A., Ali, A. A., Salmiati., Hussain, N., Muhammad, M. S., Kristanti, R. A., & Hadibarata, T., 2016. Removal of Remazol Brilliant Blue R from Aqueous Solution by Adsorption Using Pineapple Keaf Powder and Lime Peel Powder. *Water, Air, and Soil Pollution*, 227(195) : 1-11.
- Singh, A., Ghosh, A., & Dastidar, M. G., 2018. Decolorization of Reactive Yellow 17 Dye Using *Aspergillus tamarii*. *Environmental Pollution*, 77 : 309-316.
- Steingruber, E. 2004. *Indigo and Indigo Colorants*. Ullmann's Encyclopedia of Industrial Chemistry, Wiley-VCH, Weinheim.
- Torgut, G., Tanyol, M., Biryant, F., Pihtili, G., & Demirelli, K., 2017. Application of response surface methodology for optimization of Remazol Brilliant Blue R removal onto a novel polymeric adsorbent. *Journal of Taiwan Institute of Chemical Engineers*, 80 : 406-414.
- Yucel, T. T., 2018. Investigation of Some Parameters Affecting Methyl Orange Removal by *Fusarium acuminatum*. *Brazilian Archives of Biology and Technology*, 61 : 1-9.
- Zhang, F. & Yu, J., 2000. Decolorization of Acid Violet 7 With Complex Pellets of White Rot Fungus and Activated Carbon. *Bioprocess Engineering*, 23(3) : 295-301