PEATLAND FUNGI: IDENTIFICATION, APPLICATION IN DYE DECOLOURIZATION AND BACTERIAL INACTIVATION IN GREYWATER

EFAQ ALI NOMAN MOHAMMED

A thesis submitted in fulfilment of the requirement for the award of the Doctor of Philosophy in Science

Faculty of Applied Sciences and Technology

Universiti Tun Hussein Onn Malaysia

MAY 2021

DEDICATION

This thesis is dedicated to:

Soul of my beloved Father: Ali Noman

Whose words of encouragement and push for tenacity ring in my ears

My beloved mother: For her endless love, support and encouragement.

Treasure, My lovely husband: Adel Al-Gheethi

Who has always loved me unconditionally and whose good examples have taught me to work hard for the things that I aspire to achieve. I am truly thankful for having you in my life.

To my beloved kids

HALA, JULIA, AMIR and ALI

All of you have been my best cheerleaders.

To my beloved younger brothers and sisters

ACKNOWLEDGEMENT

I give thanks to ALLAH Almighty Who gives me life, purpose and contentment and for His everlasting grace, infinite love and unquantifiable mercy He has bestowed upon me for life and for eternity.

I wish to express my profound gratitude to my supervisors Dr. Balkis A. Talip and Associate Prof. Ts. Dr. Radin Maya Saphira Radin Mohamed and Associate Prof Dr. Hideyuki Nagao who by their often persistence corrections, helpful suggestions, sage advice, comments, guidance, assistance and encouragement aided our research in innumerable ways and led to the birth of this Thesis. I earnestly thank you for your ways of understanding, for the things you have done so thoughtfully, and for your encouragement in the hopes and plans we shared. Under their mentorship, I have learned a lot.

My wholehearted thanks and acknowledgement must go also to Universiti Tun Hussein Onn Malaysia a for allowing me to conduct my research and providing any assistance requested.

ALHAMDULILLAH

ABSTRACT

Fungi have unique characteristics since they have several applications in the environment and industry due to its ability to produce the different enzyme. This study aims to isolate a new fungal strain from Pontian peatland, Johor, Malaysia to be used for dye decolourizing in the synthetic greywater as a function of laccase (LAC), manganese peroxidase (MnP) and lignin peroxidase (LiP). The bio-synthesized nanoparticles (bimetallic Zn/Cu NPs) in the secondary metabolic products generated during the enzyme production in pumpkin peels medium was evaluated for inactivating *Escherichia coli* and *Staphylococcus aureus* seeded in greywater. The fungal isolates were identified according to phenotypic characteristics and by molecular characteristic at D1/D2 region and ITS (ITS_1- ITS_4) sequences. The decolourization, enzyme production and inactivation process were optimised using response surface methodology (RSM). The mechanism of decolourization and inactivation process was investigated based on Field Emission Scanning Electron Microscopy with Energy Dispersive X-Ray Spectroscopy (FESEM-EDX), Fourier transforms infrared spectroscopy (FTIR), atomic force microscopy (AFM) and Raman Spectroscopy analysis. The results revealed that *Aspergillus iizukae* EAN605, *Aspergillus arenarioides* EAN603, *Penicillium pedernalense* EAN604, *Purpureocillium lilacinum* EAN601, *Paraconiothyrium brasiliense* EAN202 and *Parengyodontium album* EAN602 were new strains and first time recorded in Malaysia. The best dye decolourization (78.34%) was 57.15 mg 100 mL^{-1} of dye, pH 6 and after 8.5 days (R^2=77.9%). The oxidative enzyme production was recorded with 20 g 100 mL^{-1} of pumpkin peels, ^{1}, 4.6 mL/100 mL^{-1} of inoculum size, at pH 5.5 and after 10 days, where 6.15, 2.58 and 127.99 U mg^{-1} of LAC, MnP and LiP was produced, respectively. The inactivation of *E. coli* and *S. aureus* by Zn/Cu NPs was effective with 0.028 mg mL^{-1} of Zn/Cu NPs, at pH 6 and after 60 mins with 5.6 and 5.2 log reduction respectively. The decolourization mechanism took place due to the action of oxidative enzymes on the inner membrane of fungal mycelium and in the surrounded medium. The inactivation process

acts by the destruction of the chemical composition of the bacterial cell wall and membrane. In conclusion, this study demonstrates that peatland has high fungal diversity to be used in the dye decolourization and synthesis of NPs for inactivating pathogenic bacteria in the greywater.

ABSTRAK

Kulat mempunyai ciri unik kerana mempunyai beberapa aplikasi dalam persekitaran dan industri kerana kemampuannya menghasilkan enzim yang berbeza. Kajian ini bertujuan untuk mengasingkan strain fungi baru dari tanah gambut di kawasan Pontian, Johor, Malaysia untuk digunakan sebagai penyahwarna untuk pewarna dalam air kelabu sintetik sebagai fungsi laccase (LAC), manganese peroxidase (MnP) dan lignin peroxidase (LiP). Nanopartikel bio-sintesis (bnetallic Zn/Cu NPs) dalam produk metabolik sekunder yang dihasilkan semasa penghasilan enzim dalam medium kulit labu dinilai dalam menyahaktifkan *Escherichia coli* dan *Staphylococcus aureus* yang diinokulasikan dalam air kelabu. Pengasingan kulat dikenalpasti mengikut ciri fenotipik dan ciri molekul di kawasan D1/D2 dan jujukan ITS (ITS1- ITS4). Proses pewarnaan, penghasilan enzim dan penyahaktifan dioptimumkan dengan menggunakan metodologi permukaan tindak balas (RSM). Mekanisme proses penyahwarnaan dan penyahaktifan ditentukan melalui Mikroskopi Elektron Pengimbasan Pelepasan Lapangan dengan Spektroskopi X-Ray Tenaga Dispersif (FESEM-EDX), spektroskopi inframerah transformasi (FTIR), Mikroskop Daya Atom (AFM) dan analisis Spektroskopi Raman. Hasil kajian menunjukkan bahawa *Aspergillus iizukae* EAN605, *Aspergillus arenarioides* EAN603, *Penicillium pedernalense* EAN604, *Purpureocillium lilacinum* EAN601, *Paraconiothyrium brasiliense* EAN202 dan *Parengyodontium album* EAN602 adalah strain baru dan pertama kalinya direkodkan di Malaysia. Penyahwarnaan pewarna terbaik (78.34%) ialah 57.15 mg 100 mL^{-1} pewarna, pH 6 dan selepas 8.5 hari (R^2 = 77.9%). Penghasilan enzim oksidatif dicatatkan dengan 20 g 100 mL^{-1} kulit labu, 4.6 mL / 100 mL^{-1} ukuran inokulum, pada pH 5.5 dan selepas 10 hari, di mana masing-masing 6.15, 2.58 dan 127.99 U mg^{-1} LAC , MnP dan LiP dihasilkan. Ketidakaktifan *E. coli* dan *S. aureus* oleh Zn / Cu NPs berkesan dengan 0.028 mg mL^{-1} Zn / Cu NPs, pada pH 6 dan selepas 60 minit dengan masing-masing dengan penurunan 5.6 dan 5.2 log. Mekanisme penyahwarnaan berlaku kerana tindakan enzim oksidatif pada membran dalaman

miselium kulat dan di medium yang dikelilinginya. Proses penyahaktifan bertindak dengan merosakkan komposisi kimia dinding sel dan membran sel bakteria. Sebagai kesimpulan, kajian ini menunjukkan bahawa tanah gambut mempunyai kepelbagaian kulat yang tinggi untuk digunakan dalam penyahwarnaan pewarna dan sintesis NP untuk menyahaktifkan bakteria patogenik pada air kelabu.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATION

AB	-	Acid Blue
ABR	-	Azo Black Reactive 5 Dye
ABTS	-	2,2'-Azino-Bis (3-Ethylbenzothiazoline-6-Sulphonic Acid
AFM	-	Atomic Force Microscopy
a_w	-	Water Activity
BB	-	Brilliant Blue
BOD	-	Biochemical Oxygen Demand
BPA	-	Bisphenol A
BPB	-	Bromophenol Blue
BSA	-	Bovine Serum Albumin
CBX	-	Cationic Blue X-Grl
CCD	-	Central Composite Design
CCZ	-	Cup-Plate Clearing Zone
CM	-	Cell Membrane
COD	-	Chemical Oxygen Demand
CR	-	Congo Red
CSB	-	Chicago Sky Blue
CW	-	Cell Wall
CY	-	Cationic Yellow 28
CYA	-	Czapek Yeast Extract Agar
CZ	-	Czapek-Dox Agar
CZR	-	Cz Medium With Rose Bengal
DMP	-	2,6-Dimethoxylphenol

DMSO	-	Dimethyl Sulphoxide
DR	-	Direct Red 28
DW	-	Distilled Water
DY	-	Direct Yelow 12
EVA	-	Pumpkin Medium (Eva)
FA	-	Ferulic Acid
FESEM-EDX	-	Field Emission Scanning Electron Microscopy With Energy Dispersive X-Ray Spectroscopy
FTIR	-	Fourier Transform Infrared Spectroscopy
GA	-	Gallic Acid
GC–MS	-	Gas Chromatography-Mass Spectrometry
HABs	-	Harmful Algae Blooms
HBT	-	1-Hydroxy-Benzotriazole
HPLC	-	High Performance Liquid Chromatography
IC	-	Indigo Carmine
IU	-	International Units
LiP	-	Lignin Peroxidase
MB	-	Methylene Blue
MEA	-	Malt Extract Agar
MG	-	Malachite Green
MHA	-	Müller-Hinton Agar
MnP	-	Manganese Peroxidase
MO	-	Methyl Orange
NMR	-	Nuclear Magnetic Resonance
NP	-	Nonylphenol
NPs	-	Nanoparticles
PDA	-	Potato Dextrose Agar
PDR	-	Polymeric Dye R

REFERENCES

Ademakinwa, A. N., & Agboola, F. K. (2016). Biochemical characterization and kinetic studies on a purified yellow laccase from newly isolated Aureobasidium pullulans NAC8 obtained from soil containing decayed plant matter. *Journal of Genetic Engineering and Biotechnology*, *14*(1), 143-151.

Ahmad, S. A., Das, S. S., Khatoon, A., Ansari, M. T., Afzal, M., Hasnain, M. S., & Nayak, A. K. (2020). Bactericidal Activity of Silver Nanoparticles: A Mechanistic Review. *Materials Science for Energy Technologies*. 3, 756-769

Ahmed, A.A.Q., Babalola, O.O. & Mckay, T., (2016) Lignin degradation by two isolated bacillus spp. and their co-culture potential in the production of platform chemicals from lignin. *Chemtech*'16, P.40.

Al-Enazi, N. M., Awaad, A. S., Al-Othman, M. R., Al-Anazi, N. K., & Alqasoumi, S. I. (2018). Isolation, identification and anti-candidal activity of filamentous fungi from Saudi Arabia soil. *Saudi Pharmaceutical Journal*, *26*(2), 253-257.

Alexopoulos, C.J., Mims, C.W. & Blackwell, M. (1996). Phylum Chytridiomycota. Introductory Mycology. John Wiley & Sons, New York, pp.86-126.

Al-Gheethi, A. A., Mohamed, R. M. S. R., Efaq, A. N., Norli, I., Abd Halid, A., Amir, H. K., & Ab Kadir, M. O. (2016). Bioaugmentation process of secondary effluents for reduction of pathogens, heavy metals and antibiotics. *Journal of Water and Health*, *14*(5), 780-795.

Al-Gheethi, A. A., Radin Mohamed, R. M. S., Efaq, A. N., & Amir Hashim, M. K. (2016). Reduction of microbial risk associated with greywater by disinfection processes for irrigation. *Journal of water and health*, *14*(3), 379-398.

Almeida, E. J. R., & Corso, C. R. (2014). Comparative study of toxicity of azo dye Procion Red MX-5B following biosorption and biodegradation treatments with the fungi *Aspergillus niger* and *Aspergillus terreus*. *Chemosphere*, *112*, 317-322.

Anastasi, A., Prigione, V., Casieri, L., & Varese, G. C. (2009). Decolourisation of model and industrial dyes by mitosporic fungi in different culture conditions. *World Journal of Microbiology and Biotechnology*, *25*(8), 1363-1374.

APHA (2005) *Standard Methods for the Examination of Water and Wastewater, in, 21st edn*, American Public Health Association (APHA), Washington, DC.

Arantes, V., & Milagres, A. M. F. (2007). The synergistic action of ligninolytic enzymes (MnP and Laccase) and Fe3+-reducing activity from white-rot fungi for degradation of Azure B. *Enzyme and microbial technology*, *42*(1), 17-22.

Archibald, F. S. (1992). A new assay for lignin-type peroxidases employing the dye azure B. *Applied and environmental microbiology*, *58*(9), 3110-3116.

Archibald, F. S., Bourbonnais, R., Jurasek, L., Paice, M. G., & Reid, I. D. (1997). Kraft pulp bleaching and delignification by *Trametes versicolor*. *Journal of biotechnology*, *53*(2-3), 215-236.

Argumedo-Delira, R., Gómez-Martínez, M. J., & Uribe-Kaffure, R. (2021). Trichoderma Biomass as an Alternative for Removal of Congo Red and Malachite Green Industrial Dyes. *Applied Sciences*, *11*(1), 448.

Arunmozhi Balajee, S., Sigler, L., & Brandt, M. E. (2007). DNA and the classical way: identification of medically important molds in the 21st century. *Medical Mycology*, *45*(6), 475-490.

Asadi, S., & Moeinpour, F. (2019). Inactivation of *Escherichia coli* in water by silver-coated Ni 0.5 Zn 0.5 Fe 2 O 4 magnetic nanocomposite: a Box–Behnken design optimization. *Applied Water Science*, *9*(1), 23.

Asgher, M., Khan, S. W., & Bilal, M. (2016). Optimization of lignocellulolytic enzyme production by Pleurotus eryngii WC 888 utilizing agro-industrial residues and bio-ethanol production. *Romanian Biotechnological Letters*, *21*(1), 11133.

Asgher, M., Wahab, A., Bilal, M., & Iqbal, H. M. N. (2016). Lignocellulose degradation and production of lignin modifying enzymes by Schizophyllum commune IBL-06

in solid-state fermentation. *Biocatalysis and Agricultural Biotechnology*, *6*, 195-201.

Badmus, K. O., Irakoze, N., Adeniyi, O. R., & Petrik, L. (2020). Synergistic advance Fenton oxidation and hydrodynamic cavitation treatment of persistent organic dyes in textile wastewater. *Journal of Environmental Chemical Engineering*, *8*(2), 103521.

Bagewadi, Z. K., Mulla, S. I., & Ninnekar, H. Z. (2017). Purification and immobilization of laccase from Trichoderma harzianum strain HZN10 and its application in dye decolorization. *Journal of Genetic Engineering and Biotechnology*, *15*(1), 139-150.

Bala, J. D., Lalung, J., Al-Gheethi, A. A., Kaizar, H., & Ismail, N. (2018). Reduction of organic load and biodegradation of palm oil mill effluent by aerobic indigenous mixed microbial consortium isolated from palm oil mill effluent (POME). *Water Conservation Science and Engineering*, *3*(3), 139-156.

Baldrian, P. (2006). Fungal laccases–occurrence and properties. *FEMS microbiology reviews*, *30*(2), 215-242.

Barnett, H. L., & Hunter, B. B. (1998). *Illustrated genera of imperfect fungi* (No. Ed. 4). American Phytopathological Society (APS Press).

Baun, A., Eriksson, E., Ledin, A., & Mikkelsen, P. S. (2006). A methodology for ranking and hazard identification of xenobiotic organic compounds in urban stormwater. *Science of the total environment*, *370*(1), 29-38.

Baun, A., Sørensen, S. N., Rasmussen, R. F., Hartmann, N. B., & Koch, C. B. (2008). Toxicity and bioaccumulation of xenobiotic organic compounds in the presence of aqueous suspensions of aggregates of nano-C60. *Aquatic Toxicology*, *86*(3), 379-387.

Bayramoglu, G., & Yilmaz, M. (2018). Azo dye removal using free and immobilized fungal biomasses: isotherms, kinetics and thermodynamic studies. *Fibers and Polymers*, *19*(4), 877-886.

Behera, B. C., Sethi, B. K., Mishra, R. R., Dutta, S. K., & Thatoi, H. N. (2017). Microbial cellulases–Diversity & biotechnology with reference to mangrove environment: A review. *Journal of Genetic Engineering and Biotechnology*, *15*(1), 197-210.

Bhadury, P., Bridge, P. D., Austen, M. C., Bilton, D. T., & Smerdon, G. R. (2009). Detection of fungal 18S rRNA sequences in conjunction with marine nematode 18S rRNA amplicons. *Aquatic Biology*, *5*(2), 149-155.

Bhamare, H. M., Jadhav, H. P., & Sayyed, R. Z. (2018). Statistical optimization for enhanced production of extracellular laccase from Aspergillus sp. HB_RZ4 isolated from bark scrapping. *Environmental Sustainability*, *1*(2), 159-166.

Bhargava, A., Jain, N., Gangopadhyay, S., & Panwar, J. (2015). Development of gold nanoparticle-fungal hybrid based heterogeneous interface for catalytic applications. *Process Biochemistry*, *50*(8), 1293-1300.

Bhattacharya, S. S., Garlapati, V. K., & Banerjee, R. (2011). Optimization of laccase production using response surface methodology coupled with differential evolution. *New Biotechnology*, *28*(1), 31-39.

Bonetto, L. R., Crespo, J. S., Guégan, R., Esteves, V. I., & Giovanela, M. (2021). Removal of methylene blue from aqueous solutions using a solid residue of the apple juice industry: full factorial design, equilibrium, thermodynamics and kinetics aspects. *Journal of Molecular Structure*, *1224*, 129296.

Bonugli-Santos, R. C., Vieira, G. A., Collins, C., Fernandes, T. C. C., Marin-Morales, M. A., Murray, P., & Sette, L. D. (2016). Enhanced textile dye decolorization by marine-derived basidiomycete Peniophora sp. CBMAI 1063 using integrated statistical design. *Environmental Science and Pollution Research*, *23*(9), 8659-8668.

Bouacem, K., Rekik, H., Jaouadi, N. Z., Zenati, B., Kourdali, S., El Hattab, M., ... & Bouanane-Darenfed, A. (2018). Purification and characterization of two novel peroxidases from the dye-decolorizing fungus Bjerkandera adusta strain CX-9. *International journal of biological macromolecules*, *106*, 636-646.

Bourbonnais, R., Paice, M. G., Reid, I. D., Lanthier, P., & Yaguchi, M. (1995). Lignin oxidation by laccase isozymes from Trametes versicolor and role of the mediator

2, 2'-azinobis (3-ethylbenzthiazoline-6-sulfonate) in kraft lignin depolymerization. *Applied and Environmental Microbiology*, *61*(5), 1876-1880.

Brijwani, K., Rigdon, A., & Vadlani, P. V. (2010). Fungal laccases: production, function, and applications in food processing. *Enzyme Research*, *2010*.

Brugnari, T., Pereira, M. G., Bubna, G. A., de Freitas, E. N., Contato, A. G., Corrêa, R. C. G., & Peralta, R. M. (2018). A highly reusable MANAE-agarose-immobilized Pleurotus ostreatus laccase for degradation of bisphenol A. *Science of The Total Environment*, *634*, 1346-1351.

Brunning A. (2015). Periodic Graphics: The chemistry of Pumpkins. *Chemical Engineering News*, (3) 40, 38.

Bubenheim, D., Wignarajah, K., Berry, W., & Wydeven, T. (1997). Phytotoxic effects of gray water due to surfactants. *Journal of the American Society for Horticultural Science*, *122*(6), 792-796.

Buswell, J. A., Cai, Y., & Chang, S. T. (1995). Effect of nutrient nitrogen and manganese on manganese peroxidase and laccase production by Lentinula (Lentinus) edodes. *FEMS Microbiology Letters*, *128*(1), 81-87.

Campbell, C.K., Johnson, E.M., & Warnock, D.W. (2013). *2nd Edition. A John Wiley and Sons, Ltd.*, Publication, UK.

Cardona, Y. T., Rocha, P. S., Cristina, T., Fernandes, C., & Marin-Morales, M. A. (2015). Cytotoxic and genotoxic effects of two hair dyes used in the formulation of black color. *Food and Chemical Toxicology*, *86*, 9–15.

Carroll, K. J., Reveles, J. U., Shultz, M. D., Khanna, S. N., & Carpenter, E. E. (2011). Preparation of elemental Cu and Ni nanoparticles by the polyol method: an experimental and theoretical approach. *The Journal of Physical Chemistry C*, *115*(6), 2656-2664.

Chakraborty, S., Basak, B., Dutta, S., Bhunia, B. and Dey, A. (2013). Decolorization and biodegradation of congo red dye by a novel white rot fungus *Alternaria alternata* CMERI F6. *Bioresource Technology*, 147, pp.662-666.

Chang L and Li Y (2017). One-step encapsulation of Pt-Co bimetallic nanoparticles within MOFs for advanced room temperature nanocatalysis. *Molecular Catalysis*, 433, pp.77-83.

Chen, Y.L., Tuan, H.Y., Tien, C.W., Lo, W.H., Liang, H.C. & Hu, Y.C. (2009). Augmented biosynthesis of cadmium sulfide nanoparticles by genetically engineered *Escherichia coli*. *Biotechnology Progress*, 25(5), pp.1260-1266.

Chenthamarakshan, A., Parambayil, N., Miziriya, N., Soumya, P.S., Lakshmi, M.K., Ramgopal, A., Dileep, A. & Nambisan, P. (2017). Optimization of laccase production from Marasmiellus palmivorus LA1 by Taguchi method of design of experiments. *BMC Biotechnology*, 17(1), p.12.

Choi, Y.W., Hyde, K.D. & Ho, W.H. (1999). Single spore isolation of fungi. *Fungal diversity*.

Chong, M.N., Cho, Y.J., Poh, P.E. & Jin, B. (2015). Evaluation of Titanium dioxide photocatalytic technology for the treatment of reactive Black 5 dye in synthetic and real greywater effluents. *Journal of Cleaner Production*, 89, pp.196-202.

Chou, C.H. & Lin, H.J. (1976). Autointoxication mechanism of Oryza sativa I. Phytotoxic effects of decomposing rice residues in soil. *Journal of Chemical Ecology*, 2(3), pp.353-367.

Chowdhary, A., Randhawa, H.S., Gaur, S.N., Agarwal, K., Kathuria, S., Roy, P., Klaassen, C.H. & Meis, J.F. (2013). *Schizophyllum commune* as an emerging fungal pathogen: a review and report of two cases. *Mycoses*, 56(1), pp.1-10.

Cole, G.T. & Samson, R.A. (1979). Patterns of development in conidial fungi. Pitman Publishing Ltd.

Coll, P.M., Fernandez-Abalos, J.M., Villanueva, J.R., Santamaria, R. & Perez, P. (1993). Purification and characterization of a phenoloxidase (laccase) from the lignin-degrading basidiomycete PM1 (CECT 2971). *Applied and Environmental Microbiology*, 59(8), pp.2607-2613.

Collee, J. G. Duguid, J. P. Fraser, A. G. & Marmion, B. P. (1989). Practical medical microbiology (13th ed). Longman- FE. Ltd, London. UK.

Copete-Pertuz, L.S., Alandete-Novoa, F., Plácido, J., Correa-Londoño, G.A. & Mora-Martínez, A.L. (2019). Enhancement of ligninolytic enzymes production and decolourising activity in Leptosphaerulina sp. by co–cultivation with *Trichoderma viride* and *Aspergillus terreus*. *Science of The Total Environment*, 646, pp.1536-1545.

Couto, S.R., Lopez, E. & Sanromán, M.A. (2006). Utilisation of grape seeds for laccase production in solid-state fermentors. *Journal of Food Engineering*, 74(2), pp.263-267.

Couwenberg, J. (2009). Emission factors for managed peat soils: an analysis of IPCC default values. Emission factors for managed peat soils: an analysis of IPCC default values.

Cowan, D. M., Kingsbury, T., Perez, A. L., Woods, T. A., Kovochich, M., Hill, D. S., ... & Paustenbach, D. J. (2014). Evaluation of the California Safer Consumer Products Regulation and the impact on consumers and product manufacturers. *Regulatory Toxicology and Pharmacology*, *68*(1), 23-40.

Craddock, H. A., Chattopadhyay, S., Rjoub, Y., Rosen, D., Greif, J., Lipchin, C., ... & Sapkota, A. R. (2020). Antibiotic-resistant Escherichia coli and Klebsiella spp. in greywater reuse systems and pond water used for agricultural irrigation in the West Bank, Palestinian Territories. *Environmental Research*, *188*, 109777.

Craddock, H. A., Panthi, S., Rjoub, Y., Lipchin, C., Sapkota, A., & Sapkota, A. R. (2020). Antibiotic and herbicide concentrations in household greywater reuse systems and pond water used for food crop irrigation: West Bank, Palestinian Territories. *Science of the Total Environment*, *699*, 134205.

D'Annibale, A., Stazi, S.R., Vinciguerra, V. and Sermanni, G.G. (2000). Oxirane-immobilized Lentinula edodes laccase: stability and phenolics removal efficiency in olive mill wastewater. *Journal of Biotechnology*, 77(2-3), pp.265-273.

da Cunha, K.C., Sutton, D.A., Fothergill, A.W., Gené, J., Cano, J., Madrid, H., de Hoog, S., Crous, P.W. & Guarro, J. (2013). In vitro antifungal susceptibility and molecular identity of 99 clinical isolates of the opportunistic fungal genus *Curvularia*. *Diagnostic Microbiology and Infectious Disease*, 76(2), pp.168-174

Daâssi, D., Frikha, F., Zouari-Mechichi, H., Belbahri, L., Woodward, S. & Mechichi, T. (2012). Application of response surface methodology to optimize decolourization of dyes by the laccase-mediator system. *Journal of Environmental Management*, 108, pp.84-91.

Dadfarnia, S., Shabani, A. H., Moradi, S. E., & Emami, S. (2015). Methyl red removal from water by iron based metal-organic frameworks loaded onto iron oxide nanoparticle adsorbent. *Applied Surface Science*, *330*, 85-93.

Dang-Bao T, Pla D, Favier I, Gómez M, (2017). Bimetallic nanoparticles in alternative solvents for catalytic purposes. *Catalysts*, 7(7), p.207.

Das, D., Charumathi, D., & Das, N. (2010). Combined effects of sugarcane bagasse extract and synthetic dyes on the growth and bioaccumulation properties of Pichia fermentans MTCC 189. *Journal of hazardous materials*, *183*(1-3), 497-505.

Daughton, C. G., & Ternes, T. A. (1999). Pharmaceuticals and personal care products in the environment: agents of subtle change?. *Environmental health perspectives*, *107*(suppl 6), 907-938.

De Gelder, J. (2008). *Raman spectroscopy as a tool for studying bacterial cell compounds* (Doctoral dissertation, Ghent University).

De Gussem, K., Vandenabeele, P., Verbeken, A. & Moens, L. (2007). Chemotaxonomical identification of spores of macrofungi: possibilities of Raman spectroscopy. *Analytical and Bioanalytical Chemistry*, 387(8), pp.2823-2832.

Diba, K., Kordbacheh, P., Mirhendi, S.H., Rezaie, S. & Mahmoudi, M. (2007). Identification of Aspergillus species using morphological characteristics. *Pakistan Journal of Medical Sciences*, 23(6), p.867.

Domsch KH, Gams W, Anderson TH. (2007). Compendium of soil fungi, 2nd Ed. Eching: IHW-Verlag. 672 p.

Domsch, K. H., W. Gams, & T. H. Anderson (2007). *Compendium of soil fungi*, 2nd ed. IHW-Verlag and Verlagsbuchhandlung, Eching, Germany.

dos Santos, T. C., de Brito, A. R., Bonomo, R. C. F., Pires, A. J. V., Aguiar-Oliveira, E., Silva, T. P., & Franco, M. (2017). Statistical optimization of culture conditions and characterization for ligninolytic enzymes produced from *Rhizopus* sp. using prickly palm cactus husk. *Chemical Engineering Communications*, 204(1), 55-63.

dos Santos, T.C., dos Santos Reis, N., Silva, T.P., Machado, F.D.P.P., Bonomo, R.C.F. & Franco, M. (2016). Prickly palm cactus husk as a raw material for production of ligninolytic enzymes by *Aspergillus niger*. *Food Science and Biotechnology*, 25(1), pp.205-211.

Du, L., Xu, Q., Huang, M., Xian, L. & Feng, J.X. (2015). Synthesis of small silver nanoparticles under light radiation by fungus *Penicillium oxalicum* and its application for the catalytic reduction of methylene blue. *Materials Chemistry and Physics*, 160, pp.40-47.

Eaton, D., Chang, H.M. & Kirk, T.K. (1980). *TAPPI-Journal of the Technical Association of the Pulp and Paper Industry* (USA).

El Monssef, R.A.A., Hassan, E.A. & Ramadan, E.M. (2016). Production of laccase enzyme for their potential application to decolorize fungal pigments on aging paper and parchment. *Annals of Agricultural Sciences*, 61(1), pp.145-154.

El-Elimat, T., Raja, H.A., Graf, T.N., Faeth, S.H., Cech, N.B. & Oberlies, N.H. (2014). Flavonolignans from Aspergillus iizukae, a fungal endophyte of milk thistle (Silybum marianum). *Journal of Natural Products*, 77(2), pp.193-199.

Ellis, M.B. & Ellis, J.P. (1985). *Microfungi on land plants.* An identification handbook. Croom Helm Ltd.

Embong, Z., Hitam, W.H.W., Yean, C.Y., Rashid, N.H.A., Kamarudin, B., Abidin, S.K.Z., Osman, S., Zainuddin, Z.F. & Ravichandran, M. (2008). Specific detection of fungal pathogens by 18S rRNA gene PCR in microbial keratitis. *BMC Ophthalmology*, 8(1), p.7.

Enayatizamir, N., Tabandeh, F., Rodríguez-Couto, S., Yakhchali, B., Alikhani, H.A. & Mohammadi, L. (2011). Biodegradation pathway and detoxification of the diazo dye Reactive Black 5 by *Phanerochaete chrysosporium*. *Bioresource Technology*, 102(22), pp.10359-10362.

Eriksson, E., Baun, A., Henze, M. & Ledin, A. (2006). Phytotoxicity of grey wastewater evaluated by toxicity tests. *Urban Water Journal*, 3(1), pp.13-20.

Eriksson, E., Baun, A., Henze, M., & Ledin, A. (2006). Phytotoxicity of grey wastewater evaluated by toxicity tests. *Urban Water Journal*, *3*(1), 13-20.

Eriksson, E., Baun, A., Mikkelsen, P. S., & Ledin, A. (2005). Chemical hazard identification and assessment tool for evaluation of stormwater priority pollutants. *Water Science and Technology*, *51*(2), 47-55.

Eriksson, E., Baun, A., Mikkelsen, P. S., & Ledin, A. (2007). Risk assessment of xenobiotics in stormwater discharged to Harrestrup Å, Denmark. *Desalination*, *215*(1-3), 187-197.

Espinosa-Ortiz, E.J., Rene, E.R., Pakshirajan, K., van Hullebusch, E.D. & Lens, P.N. (2016). Fungal pelleted reactors in wastewater treatment: applications and perspectives. *Chemical Engineering Journal*, 283, pp.553-571.

European Commission (2000). Proposal for a Directive of the European Parliament and of the Council on Environmental Quality Standards in the Field of Water Policy and Amending Directive 2000/60/EC, 2006 [accessed November 2016]; Available from: http://eur-lex.europa.

Evans, C. S., Gallagher, I. M., Atkey, P. T., & Wood, D. A. (1991). Localisation of degradative enzymes in white-rot decay of lignocellulose. *Biodegradation*, *2*(2), 93-106.

Evans, C.S. & Hedger, J.N. (2001), November. Degradation of plant cell wall polymers. In British Mycological Society Symposium Series (Vol. 23, pp. 1-26)

Evans, C.S., Dutton, M.V., Guillén, F. & Veness, R.G. (1994). *FEMS Microbiology Reviews*, 13(2-3), pp.235-239.

Faraco, V., Pezzella, C., Miele, A., Giardina, P. & Sannia, G. (2009). Bio-remediation of colored industrial wastewaters by the white-rot fungi *Phanerochaete chrysosporium* and *Pleurotus ostreatus* and their enzymes. *Biodegradation*, 20(2), pp.209-220.

Fathy, R. M., Salem, M. S. E. D., & Mahfouz, A. Y. (2020). Biogenic synthesis of silver nanoparticles using Gliocladium deliquescens and their application as household sponge disinfectant. *Biological trace element research*, *196*(2), 662-678.

Fazio, A.T., López, M.M., Temperini, M.L. & de Faria, D.L.A. (2018). Surface enhanced Raman spectroscopy and cultural heritage biodeterioration: Fungi identification in earthen architecture from Paraíba Valley (São Paulo, Brazil). *Vibrational Spectroscopy*, 97, pp.129-134.

Fell, J.W., Boekhout, T., Fonseca, A., Scorzetti, G. & Statzell-Tallman, A. (2000). Biodiversity and systematics of basidiomycetous yeasts as determined by large-subunit rDNA D1/D2 domain sequence analysis. *International Journal of Systematic and Evolutionary Microbiology*, 50(3), pp.1351-1371.

Field, J.A., Boelsma, F., Baten, H. & Rulkens, W.H. (1995). *Applied Mcrobiology and Biotechnology*, 44(1-2), pp.234-240.

Frisvad, J.C. (2015). Fungal chemotaxonomy. In Biosynthesis and Molecular Genetics of Fungal Secondary Metabolites, Volume 2 (pp. 103-121). Springer New York.

Fryczkowska, B. (2018). The application of ultrafiltration composite GO/PAN membranes for removing dyes from textile wastewater. *Desalin. Water Treatment*, *128*, 79-88.

Galhaup, C., Wagner, H., Hinterstoisser, B. & Haltrich, D. (2002). Increased production of laccase by the wood-degrading basidiomycete *Trametes pubescens*. *Enzyme and Microbial Technology*, 30(4), pp.529-536.

Gams, W. (2007). Biodiversity of soil-inhabiting fungi. *Biodiversity and Conservation*, 16(1), pp.69-72.

Gao, H., Chu, X., Wang, Y., Zhou, F., Zhao, K., Mu, Z. & Liu, Q. (2013). Media optimization for laccase production by *Trichoderma harzianum* ZF-2 using response surface methodology. *Journal of Microbiology and Biotechnology*, 23, pp.1757-1764.

Gao, L., Sun, M.H., Liu, X.Z. & Che, Y.S. (2007). Effects of carbon concentration and carbon to nitrogen ratio on the growth and sporulation of several biocontrol fungi. *Mycological Research*, 111(1), pp.87-92.

Gardes M, Bruns TD. (1993). ITS primers with enhanced specifity for Basidiomycetes: application to identification of mycorrhizae and rusts. *Molecular Ecology* 2:113-118

Ghorbani, H.R. Rashidi, R. (2018). Synthesis of Cu–Ag nanoparticles by biological method. *Inorganic and Nano-Metal Chemistry*, 48(1), pp.41-43.

Ghosh, A., Dastidar, M.G. & Sreekrishnan, T.R. (2018). *Bioremediation of Chromium Complex Dye by Growing Aspergillus flavus*. In Water Quality Management (pp. 81-92). Springer, Singapore.

Giancoli, Á.C.H., Azevedo, J.L.D. & Kleiner, A.A. (2010). Cytological characterization of an Aspergillus nidulans mutant from a strain with chromosomic duplication. *Brazilian Journal of Microbiology*, 41(1), pp.264-269.

Giardina, P., Palmieri, G., Fontanella, B., Rivieccio, V. & Sannia, G. (2000). Manganese peroxidase isoenzymes produced by *Pleurotus ostreatus* grown on wood sawdust. *Archives of Biochemistry and Biophysics*, 376(1), pp.171-179.

Giesy, J. P., & Snyder, E. M. (1998). Xenobiotic modulation of endocrine function in fishes. *Principles and processes for evaluating endocrine disruption in wildlife*, 155-237.

Gönen, F., & Aksu, Z. (2009). Single and binary dye and heavy metal bioaccumulation properties of Candida tropicalis: Use of response surface methodology (RSM) for the estimation of removal yields. *Journal of hazardous materials*, *172*(2-3), 1512-1519.

Grčić, I., Vrsaljko, D., Katančić, Z., & Papić, S. (2015). Purification of household greywater loaded with hair colorants by solar photocatalysis using TiO2-coated textile fibers coupled flocculation with chitosan. *Journal of Water Process Engineering*, *5*, 15-27.

Guarro, J., Gené, J. & Stchigel, A.M. (1999). Developments in fungal taxonomy. *Clinical Microbiology Reviews*, 12(3), pp.454-500.

Guerra, E., Llompart, M., & Garcia-Jares, C. (2018). Analysis of dyes in cosmetics: challenges and recent developments. *Cosmetics*, *5*(3), 47.

Guggenberger, G., Zech, W. & Schulten, H.R. (1994). Formation and mobilization pathways of dissolved organic matter: evidence from chemical structural studies of organic matter fractions in acid forest floor solutions. *Organic Geochemistry*, 21(1), pp.51-66.

Gyaurgieva, O.H., Bogomolova, T.S. & Gorshkova, G.I. (1996). Meningitis caused by Rhodotorula rubra in an HIV-infected patient. *Journal of Medical and Veterinary Mycology*, 34(5), pp.357-359.

Hadibarata, T., Tachibana, S. & Itoh, K. (2009). Biodegradation of chrysene, an aromatic hydrocarbon by Polyporus sp. S133 in liquid medium. *Journal of Hazardous Materials*, 164(2-3), pp.911-917.

Hakala, T.K., Hildén, K., Maijala, P., Olsson, C. & Hatakka, A. (2006). Differential regulation of manganese peroxidases and characterization of two variable MnP

encoding genes in the white-rot fungus *Physisporinus rivulosus*. *Applied Microbiology and Biotechnology*, 73(4), pp.839-849.

Hakim, S.S., Yuwati, T.W. & Nurulita, S. (2017). Isolation of peat swamp forest foliar endophyte fungi as biofertilizer. *Journal of Wetlands Environmental Management*, 5(1), pp.10-17.

Han, W., Fang, J., Liu, Z. & Tang, J. (2016a). Techno-economic evaluation of a combined bioprocess for fermentative hydrogen production from food waste. *Bioresource Technology*, 202, pp.107-112.

Han, W., Hu, Y., Li, S., Huang, J., Nie, Q., Zhao, H. & Tang, J. (2017). Simultaneous dark fermentative hydrogen and ethanol production from waste bread in a mixed packed tank reactor. *Journal of Cleaner Production*, 141, pp.608-611.

Han, W., Yan, Y., Gu, J., Shi, Y., Tang, J. & Li, Y. (2016b). Techno-economic analysis of a novel bioprocess combining solid state fermentation and dark fermentation for H2 production from food waste. *International Journal of Hydrogen Energy*, 41(48), pp.22619-22625.

Harms, H., Schlosser, D., & Wick, L. Y. (2011). Untapped potential: exploiting fungi in bioremediation of hazardous chemicals. *Nature Reviews Microbiology*, 9(3), 177-192.

Harris, S.D. (2012). Molecular basis of morphogenesis in fungi. In Morphogenesis and Pathogenicity in Fungi (pp. 1-20). Springer, Berlin, Heidelberg.

Hartmann, N. B., & Baun, A. (2010). The nano cocktail: ecotoxicological effects of engineered nanoparticles in chemical mixtures. *Integrated Environmental Assessment and Management: An International Journal*, *6*(2), 311-313.

Harvey, P. J., & Thurston, C. F. (2001, November). The biochemistry of ligninolytic fungi. In *British mycological society symposium series* (Vol. 23, pp. 27-51).

Hawksworth, D. L. (1991). The fungal dimension of biodiversity: magnitude, significance, and conservation. *Mycological Research*, 95(6), 641-655.

He, X.L., Song, C., Li, Y.Y., Wang, N., Xu, L., Han, X. & Wei, D.S. (2018). Efficient degradation of Azo dyes by a newly isolated fungus *Trichoderma tomentosum* under non-sterile conditions. *Ecotoxicology and Environmental Safety*, 150, pp.232-239.

Hendriks, L., De Baere, R., Van de Peer, Y., Neefs, J., Goris, A. & De Wachter, R. (1991). The evolutionary position of the rhodophyte *Porphyra umbilicalis* and the basidiomycete *Leucosporidium scottii* among other eukaryotes as deduced from complete sequences of small ribosomal subunit RNA. *Journal of Molecular Evolution*, 32(2), pp.167-177.

Hjorth, R., Hansen, S. F., Jacobs, M., Tickner, J., Ellenbecker, M., & Baun, A. (2017). The applicability of chemical alternatives assessment for engineered nanomaterials. *Integrated environmental assessment and management*, *13*(1), 177-187.

Hong, S.G., Cramer, R.A., Lawrence, C.B. & Pryor, B.M. (2005). Alt a 1 allergen homologs from Alternaria and related taxa: analysis of phylogenetic content and secondary structure. *Fungal Genetics and Biology*, 42(2), pp.119-129.

Hubka, V., Nováková, A., Kolařík, M., Jurjević, Ž. & Peterson, S.W. (2015). Revision of Aspergillus section Flavipedes: seven new species and proposal of section Jani sect. nov. *Mycologia*, 107(1), pp.169-208.

Hulkoti, N.I. & Taranath, T.C. (2014). Biosynthesis of nanoparticles using microbes—a review. *Colloids and Surfaces B: Biointerfaces*, 121, pp.474-483.

Ishak, S.A., Murshed, M.F., Md Akil, H., Ismail, N., Md Rasib, S.Z. & Al-Gheethi, A.A.S. (2020). The Application of Modified Natural Polymers in Toxicant Dye Compounds Wastewater: A Review. *Water*, 12(7), p.2032.

Jacobs, M. M., Malloy, T. F., Tickner, J. A., & Edwards, S. (2016). Alternatives assessment frameworks: research needs for the informed substitution of hazardous chemicals. *Environmental health perspectives*, *124*(3), 265-280.

Jain, N., Bhargava, A., Majumdar, S., Tarafdar, J.C. & Panwar, J. (2011). Extracellular biosynthesis and characterization of silver nanoparticles using *Aspergillus flavus* NJP08: a mechanism perspective. *Nanoscale*, 3(2), pp.635-641.

Jarvis, R.M. & Goodacre, R. (2008). Characterisation and identification of bacteria using SERS. *Chemical Society Reviews*, 37(5), pp.931-936.

Jarvis, R.M., Brooker, A. & Goodacre, R. (2006). Surface-enhanced Raman scattering for the rapid discrimination of bacteria. Faraday Discussions, 132, pp.281-292.

Jasińska, A., Góralczyk, A., Soboń, A. and Długoński, J. (2018). Novel laccase-like multicopper oxidases from the fungus Myrothecium roridum-production enhancement, identification and application in dyes removal. *Acta Biochimica Polonica*.

Jerger, D. E. & Woodhull, P. (1999). Technology development for biological treatment of explosives-contaminated soils. In Bioremediation of Nitroaromatic and Haloaromatic Compounds, eds. B. C. Alleman & A. Leeson, pp. 33–44. Columbus, OH: Battelle Press.

Jia, B., Niu, Z., Wu, Y., Kuzyakov, Y., & Li, X. G. (2020). Waterlogging increases organic carbon decomposition in grassland soils. *Soil Biology and Biochemistry, 148*, 107927.

Jin, X. & Ning, Y. (2013). Laccase production optimization by response surface methodology with Aspergillus fumigatus AF1 in unique inexpensive medium and decolorization of different dyes with the crude enzyme or fungal pellets. *Journal of Hazardous Materials*, 262, pp.870-877.

Jones, J. G., Knight, M., & Byrom, J. A. (1970). Effect of gross pollution by kerosine hydrocarbons on the microflora of a moorland soil. *Nature*, 227(5263), 1166-1166.

Joosten, H. & Clarke, D. (2002). Wise use of mires and peatlands. International Mire Conservation Group and International Peat Society, 304.

Jurjević, Ž., Kubátová, A., Kolařík, M. & Hubka, V. (2015). Taxonomy of Aspergillus section Petersonii sect. nov. encompassing indoor and soil-borne species with predominant tropical distribution. *Plant Systematics and Evolution*, 301(10), pp.2441-2462.

Kalantari, B. & Prasad, A. (2014). A study of the effect of various curing techniques on the strength of stabilized peat. *Transportation Geotechnics*, 1(3), pp.119-128.

Kalra, K., Chauhan, R., Shavez, M., Sachdeva, S. (2013). Isolation of laccase producing Trichoderma spp. and effect of pH and temperature on its activity. *International Journal of Environmental Science and Technology* 5 (5), 2229–2235.

Kang, H.H., Zhang, H.B., Zhong, M.J., Ma, L.Y., Liu, D.S., Liu, W.Z. & Ren, H. (2018). Potential antiviral xanthones from a Coastal Saline Soil Fungus *Aspergillus iizukae*. *Marine Drugs*, 16(11), p.449.

Karim, N.F.A., Mohd, M., Nor, N.M.I.M. & Zakaria, L. (2016). Saprophytic and potentially pathogenic Fusarium species from peat soil in Perak and Pahang. *Tropical Life Sciences Research*, 27(1), p.1.

Karnan, T. & Selvakumar, S.A.S. (2016). Biosynthesis of ZnO nanoparticles using rambutan (Nephelium lappaceumL.) peel extract and their photocatalytic activity on methyl orange dye. *Journal of Molecular Structure*, 1125, pp.358-365.

Karp, S.G., Faraco, V., Amore, A., Birolo, L., Giangrande, C., Soccol, V.T., Pandey, A. & Soccol, C.R. (2012). Characterization of laccase isoforms produced by *Pleurotus ostreatus* in solid state fermentation of sugarcane bagasse. *Bioresource Technology*, 114, pp.735-739.

Karthik, V., Sivarajasekar, N., Padmanaban, V.C., Nakkeeran, E. & Selvaraju, N. (2018). Biosorption of xenobiotic Reactive Black B onto metabolically inactive *T. harzianum* biomass: optimization and equilibrium studies. *International Journal of Environmental Science and Technology*, pp.1-12.

Kaur, B., Kumar, B., Garg, N. & Kaur, N. (2015). Statistical optimization of conditions for decolorization of synthetic dyes by Cordyceps militaris MTCC 3936 using RSM. *BioMed Research International*, (2015).

Kaushik, P., & Malik, A. (2010). Alkali, thermo and halo tolerant fungal isolate for the removal of textile dyes. *Colloids and Surfaces B: Biointerfaces*, *81*(1), 321-328.

Kern, J., Tammeorg, P., Shanskiy, M., Sakrabani, R., Knicker, H., Kammann, C., Tuhkanen, E.M., Smidt, G., Prasad, M., Tiilikkala, K. & Sohi, S. (2017). Synergistic use of peat and charred material in growing media–an option to reduce the pressure on peatlands. *Journal of Environmental Engineering and Landscape* Management, *25*(2), pp.160-174.

Khan, S.A., Noreen, F., Kanwal, S., Iqbal, A. & Hussain, G. (2018). Green synthesis of ZnO and Cu-doped ZnO nanoparticles from leaf extracts of Abutilon indicum, Clerodendrum infortunatum, Clerodendrum inerme and investigation of their

biological and photocatalytic activities. *Materials Science and Engineering*: C, 82, pp.46-59.

Kim, M. K., & Zoh, K. D. (2016). Occurrence and removals of micropollutants in water environment. *Environmental Engineering Research*, *21*(4), 319-332.

Kin, P.K., Azmi W.A., Kamarudin, N., Ali S. & Moslim R (2017) The occurrence of entomopathogenic fungi on mineral and peat soils in Peninsular Malaysia, American *Journal of Agricultural and Biological Sciences*. 12 (1), 1-12

Kirk, P.M., Cannon, P. F., Minter, D. W. & Stalpers, J. A. (2008). *Dictionary of the Fungi*, 10th ed. CABI, Wallingford, UK.

Klich MA. (2002). Biogeography of *Aspergillus* species in soil and litter. Mycologia 94:21–27,

Knapp, J.S. & Newby, P.S. (1999). The decolourisation of a chemical industry effluent by white rot fungi. *Water Research*, 33(2), pp.575-577.

Knapp, J.S. (2001). Use of wood-rotting fungi for the decolorization of dyes and industrial. *Fungi in Bioremediation*, (23), 242.

Kodal, S.P. & Aksu, Z. (2017). Cationic surfactant-modified biosorption of anionic dyes by dried *Rhizopus arrhizus*. *Environmental Technology*, 38(20), pp.2551-2561.

Kool, M. (2006). *Mathematical Model for Antibiotic Distribution and Eradication of Bacteria Causing Endocarditi*s. MSc. Thesis, University of Twente, the Netherlands, Department of Applied Mathematics, Group of Applied Analysis and Mathematical Physics, (2006)

Kruk, T., Szczepanowicz, K., Stefańska, J., Socha, R.P. & Warszyński, P. (2015). Synthesis and antimicrobial activity of monodisperse copper nanoparticles. *Colloids and surfaces B: Biointerfaces*, 128, pp.17-22.

Kumar, M., Singh, G., Arya, S.K., Bhatti, J.S. & Sharma, P. (2018). Artificial Neuro-Fuzzy Inference System (ANFIS) based validation of laccase production using RSM model. *Biocatalysis and Agricultural Biotechnology*, 14, pp.235-240.

Kumara, K.L. & Rawal, R.D. (2010). Influence of carbon, nitrogen, temperature and pH on the growth and sporulation of some Indian isolates of *Colletotrichum*

gloeosporioides causing anthracnose disease of papaya (Carrica papaya L). T*ropical Agricultural Research & Extension*, 11.

Kurakov, A.V., Lavrent'Ev, R.B., Nechitailo, T.Y., Golyshin, P.N. & Zvyagintsev, D.G. (2008). Diversity of facultatively anaerobic microscopic mycelial fungi in soils. *Microbiology*, 77(1), pp.90-98.

Kwan, T.H., Pleissner, D., Lau, K.Y., Venus, J., Pommeret, A. & Lin, C.S.K. (2015). Techno-economic analysis of a food waste valorization process via microalgae cultivation and co-production of plasticizer, lactic acid and animal feed from algal biomass and food waste. *Bioresource Technology*, 198, pp.292-299.

Laich, F. & Andrade, J. (2016). *Penicillium pedernalense* sp. nov., isolated from whiteleg shrimp heads waste compost. *International Journal of Systematic and Evolutionary Microbiology*, 66(11), pp.4382-4388.

Latiffah, Z., Nurul Izzati, H. & Baharuddin, S. (2010). *Fusarium* species isolated from peat soil of Pondok Tanjung and Sungai Beriah, Perak. *Malaysian J. Microbiol*, 6, pp.102-105.

Ledin, A., Eriksson, E. & Henze, M. (2004). *Aspects of groundwater recharge using grey wastewater*. In Decentralised sanitation and reuse: Concepts, systems and implementation (pp. 222-231). *Chemical Industry Press*, China.

Lee, H., Jang, Y., Choi, Y.S., Kim, M.J., Lee, J., Lee, H., Hong, J.H., Lee, Y.M., Kim, G.H. & Kim, J.J. (2014). Biotechnological procedures to select white rot fungi for the degradation of PAHs. *Journal of Microbiological Methods*, 97, pp.56-62.

Lee, S.S., Horak, E., Alias, S.A., Thi, B.K., Nazura, Z., Jones, E.B.G. & Nawawi, A. (2008). Checklist of Literature on Malaysian Macrofungi.

Leontievsky, A.A., Vares, T., Lankinen, P., Shergill, J.K., Pozdnyakova, N.N., Myasoedova, N.M., Kalkkinen, N., Golovleva, L.A., Cammack, R., Thurston, C.F. & Hatakka, A. (1997). Blue and yellow laccases of oxidative fungi. *FEMS Microbiology Letters*, 156(1), pp.9-14.

Leslie, J.F. & Summerell, B.A. (2008). *The Fusarium laboratory manual*. John Wiley & Sons.

Levin, L., Herrmann, C. & Papinutti, V.L. (2008). Optimization of lignocellulolytic enzyme production by the white-rot fungus Trametes trogii in solid-state fermentation using response surface methodology. *Biochemical Engineering Journal*, 39(1), pp.207-214.

Li, L.J., Li, T.X., Kong, L.Y. & Yang, M.H. (2016). Antioxidant aromatic butenolides from an insect-associated Aspergillus iizukae. *Phytochemistry Letters*, 16, pp.134-140.

Li, S., Huang, X., Shen, J., Xu, F., & Su, J. (2020). Effects of plant diversity and soil properties on soil fungal community structure with secondary succession in the Pinus yunnanensis forest. *Geoderma*, *379*, 114646.

Liang, J., Ning, X.A., Kong, M., Liu, D., Wang, G., Cai, H., Sun, J., Zhang, Y., Lu, X. & Yuan, Y. (2017). Elimination and ecotoxicity evaluation of phthalic acid esters from textile-dyeing wastewater. *Environmental Pollution*, 231, pp.115-122.

Lieckfeldt, E., Samuels, G.J., Nirenberg, H.I. & Petrini, O. (1999). A morphological and molecular perspective of *Trichoderma viride*: is it one or two species?. *Applied and Environmental Microbiology*, 65(6), pp.2418-2428..

Liguori, B., Hansen, S. F., Baun, A., & Jensen, K. A. (2016). Control banding tools for occupational exposure assessment of nanomaterials—Ready for use in a regulatory context?. *NanoImpact*, *2*, 1-17.

Liu, C.H., Liu, R.H., Sun, Q.J., Chang, J.B., Gao, X., Liu, Y., Lee, S.T., Kang, Z.H. & Wang, S.D. (2015). Controlled synthesis and synergistic effects of graphene-supported PdAu bimetallic nanoparticles with tunable catalytic properties. *Nanoscale*, 7(14), pp.6356-6362.

Liu, D., Yan, L., Ma, L., Huang, Y., Pan, X., Liu, W. & Lv, Z. (2015). Diphenyl derivatives from coastal saline soil fungus *Aspergillus iizukae*. *Archives of Pharmacal Research*, 38(6), pp.1038-1043.

Ljunggren, M. & Zacchi, G. (2010). Techno-economic evaluation of a two-step biological process for hydrogen production. *Biotechnology Progress*, 26(2), pp.496-504.

Lonappan, L., Liu, Y., Rouissi, T., Brar, S.K., Verma, M. & Surampalli, R.Y. (2018). Adsorptive immobilization of agro-industrially produced crude laccase on various micro-biochars and degradation of diclofenac. *Science of The Total Environment*, 640, pp.1251-1258.

Lu, T., Zhang, Q. & Yao, S. (2017). Efficient decolourization of dye-containing wastewater using mycelial pellets formed of marine-derived *Aspergillus niger*. *Chinese Journal of Chemical Engineering*, 25(3), pp.330-337.

Lupica, S. (2013). Effects of Textile Dyes in Wastewater, eHow Contributor, Available online:www.ehow.com/info_8379849_effects-textile-dyes-wastewater.html (accessed 29.06.19).

Lupica, S., (2013) Effects of textile dyes in wastewater, eHow Contributor, Available online: www.ehow.com/info_8379849_effects-textile-dyes-wastewater.html (accessed 29.06.2020).

Machado, K.M.G. & Matheus, D.R. (2006). Biodegradation of remazol brilliant blue R by ligninolytic enzymatic complex produced by *Pleurotus ostreatus*. *Brazilian Journal of Microbiology*, 37(4), pp.468-473.

Macia´-Vicente JG, Ferraro V, Burruano S, Lopez-Llorca LV. (2012). Fungal assemblages associated with roots of halophytic and non-halophytic plant species vary differentially along a salinity gradient. *Microbiology Ecology* 64:668–679.

Mahmoud, M.S., Mostafa, M.K., Mohamed, S.A., Sobhy, N.A. & Nasr, M. (2017). Bioremediation of red azo dye from aqueous solutions by *Aspergillus niger* strain isolated from textile wastewater. *Journal of Environmental Chemical Engineering*, 5(1), pp.547-554.

Majeau, J.A., Brar, S.K. & Tyagi, R.D. (2010). Laccases for removal of recalcitrant and emerging pollutants. *Bioresource Technology*, 101(7), pp.2331-2350.

Manai, I., Miladi, B., El Mselmi, A., Smaali, I., Hassen, A.B., Hamdi, M. & Bouallagui, H. (2016). Industrial textile effluent decolourization in stirred and static batch cultures of a new fungal strain *Chaetomium globosum* IMA1 KJ472923. *Journal of Environmental Management*, 170, pp.8-14.

Margot, J., Bennati-Granier, C., Maillard, J., Blánquez, P., Barry, D.A. & Holliger, C. (2013). Bacterial versus fungal laccase: potential for micropollutant degradation. AMB Express, 3(1), p.63.

Masarbo, R.S., Ismailsab, M., Monisha, T.R., Nayak, A.S. & Karegoudar, T.B. (2018). *Bioremediation Journal*, 22(3-4), pp.136-146.

Melchers, W.J., Verweij, P.E., Van den Hurk, P., Van Belkum, A., De Pauw, B.E., Hoogkamp-Korstanje, J.A. & Meis, J.F. (1994). General primer-mediated PCR for detection of *Aspergillus* species. *Journal of Clinical Microbiology*, 32(7), pp.1710-1717.

Mesri, G. & Ajlouni, M. (2007). Engineering properties of fibrous peats. *Journal of Geotechnical and Geoenvironmental Engineering*, 133(7), pp.850-866.

Meyer R, Plaskowitz JS (1989). Scanning electron microscopy of conidia and conidial matrix of *Trichoderma*. *Mycologia* 81: 312–317.

Mishra, V., Jana, A.K., Jana, M.M. & Gupta, A. (2017). Enhancement in multiple lignolytic enzymes production for optimized lignin degradation and selectivity in fungal pretreatment of sweet sorghum bagasse. *Bioresource Technology*, 236, pp.49-59.

Mohamed, R. M. S. R., Al-Gheethi, A. A., Miau, J. A., & Kassim, A. H. M. (2016). Multi-component Filters for Domestic Graywater Treatment in Village Houses. *Journal-American Water Works Association*, 108(7), E405-E415.

Mohammadi-Aloucheh, R., Habibi-Yangjeh, A., Bayrami, A., Latifi-Navid, S. and Asadi, A. (2018). Enhanced anti-bacterial activities of ZnO nanoparticles and Cu/Zn nanocomposites synthesized using Vaccinium arctostaphylos L. fruit extract. Artificial cells, nanomedicine, and biotechnology, 46(sup1), pp.1200-1209

More, S. S., PS, R., Malini, S. (2011). Isolation, purification, and characterization of fungal laccase from Pleurotus sp. *Enzyme Research*, (2011).

Moreira, P.R., Duez, C., Dehareng, D., Antunes, A., Almeida-Vara, E., Frère, J.M., Malcata, F.X. and Duarte, J.C. (2005). Molecular characterisation of a versatile peroxidase from a Bjerkandera strain. *Journal of Biotechnology*, 118(4), pp.339-352.

Morse, A. & Jackson, A. (2003). Fate of a representative pharmaceutical in the environment. Texas Water Resources Institute.

Müller-Herold, U., Morosini, M., & Schucht, O. (2005). Choosing chemicals for precautionary regulation: a filter series approach.

Muntanjola-Cvetković, M. & Vukić, V.V. (1972). Influence of light on hülle cell and aleuriospore formation in *Aspergillus*. *Transactions of the British Mycological Society*, 58(1), pp.67-IN11.

Murugesan, K., Dhamija, A., Nam, I.H., Kim, Y.M. & Chang, Y.S. (2007). Decolourization of reactive black 5 by laccase: optimization by response surface methodology. *Dyes and Pigments*, 75(1), pp.176-184.

Nadeau, R., Singhvi, R., Ryabik, J., Lin, Y.H. & Syslo, J. (1993). Monitoring for bioremediation efficacy: the marrow marsh experience. In International Oil Spill Conference (Vol. 1993, No. 1, pp. 477-485). American Petroleum Institute.

Nakada, M., Tanaka, C., Tsunewaki, K. & Tsuda, M. (1994). RFLP analysis for species separation in the genera Bipolaris and Curvularia. *Mycoscience*, 35(3), pp.271-278

Nasrollahzadeh M, Azarian A, Maham M, Ehsani A (2015) Synthesis of Au/Pd bimetallic nanoparticles and their application in the Suzuki coupling reaction. *Journal* of *Industrial* and *Engineering Chemistry*, 21, pp.746-748.

Niku-Paavola, M.L. & Viikari, L. (2000). Enzymatic oxidation of alkenes. *Journal of Molecular Catalysis B: Enzymatic*, 10(4), pp.435-444.

NMRC (2019). Mycology Online. *National Mycology Reference Centre*, the University of Adelaide. http://www.mycology.adelaide.edu.au Date 2 January (2019).

Nolte, T. M., Hartmann, N. B., Kleijn, J. M., Garnæs, J., Van De Meent, D., Hendriks, A. J., & Baun, A. (2017). The toxicity of plastic nanoparticles to green algae as influenced by surface modification, medium hardness and cellular adsorption. *Aquatic toxicology*, *183*, 11-20.

Noman, E., Al-Gheethi, A.A., Rahman, N.K., Talip, B., Mohamed, R. & Kadir, O.A. (2018), April. Single spore isolation as a simple and efficient technique to obtain fungal pure culture. In IOP Conference Series: *Earth & Environmental Science* (Vol. 140, No. 1, p. 012055). IOP Publishing.

Nurulita, Y., Adetutu, E.M., Gunawan, H., Zul, D. & Ball, A.S. (2016). Restoration of tropical peat soils: The application of soil microbiology for monitoring the success of the restoration process. *Agriculture, Ecosystems & Environment*, 216, pp.293-303.

Nyholm, N., & Källqvist, T. (1989). Methods for growth inhibition toxicity tests with freshwater algae. *Environmental Toxicology and Chemistry: An International Journal*, *8*(8), 689-703.

O'Donnell K, Kistler HC, Cigelnik E, Ploetz RC. (1998b). Multiple evolutionary origins of the fungus causing Panama disease of banana: Concordant evidence from nuclear and mitochondrial gene genealogies. *Proceedings of the National Academy of Sciences of the United States of America* 95:2044-2049.

Oberdörster, E. & Cheek, A.O. (2001). Gender benders at the beach: endocrine disruption in marine and estuarine organisms. *Environmental Toxicology and Chemistry*, 20(1), pp.23-36.

Okuda, T. & Yamamoto, K. (2000). Materials for the fungus flora of Japan *Mariannaea camptospora* and M. elegans var. punicea from Japan. Mycoscience, 41(4), pp.411-414.

Oliveira, A. G., de Lara Andrade, J., Montanha, M. C., Lima, S. M., da Cunha Andrade, L. H., Hechenleitner, A. A. W., & de Oliveira, D. M. F. (2019). Decontamination and disinfection of wastewater by photocatalysis under UV/visible light using nano-catalysts based on Ca-doped ZnO. *Journal of environmental management*, *240*, 485-493.

Omar, F.N., Ismael, N.H. & Ali, S.R.A. (2012). Fungi associated with deep peat soil Sarawak. In UMT 11th International Annual Symposium on Sustainability Science and Management (pp. 239-245).

Osma, J. F., Toca-Herrera, J. L., & Rodríguez-Couto, S. (2010). Transformation pathway of Remazol Brilliant Blue R by immobilised laccase. *Bioresource technology*, *101*(22), 8509-8514. Osma, J. F., Toca-Herrera, J. L., & Rodríguez-Couto, S. (2010). Transformation pathway of Remazol Brilliant Blue R by immobilised laccase. *Bioresource technology*, *101*(22), 8509-8514.

Osma, J.F., Toca-Herrera, J.L. & Rodríguez-Couto, S. (2010). *Bioresource Technology*, 101(22), pp.8509-8514.

Ovais, M., Khalil, A.T., Ayaz, M., Ahmad, I., Nethi, S.K. & Mukherjee, S. (2018). Biosynthesis of metal nanoparticles via microbial enzymes: a mechanistic approach. *International Journal of Molecular Sciences*, 19(12), p.4100.

Pasti, M.B. & Crawford, D.L. (1991). Relationships between the abilities of streptomycetes to decolorize three anthron-type dyes and to degrade lignocellulose. *Canadian Journal of Microbiology*, 37(12), pp.902-907.

Pereira, L., Mehboob, F., Stams, A.J., Mota, M.M., Rijnaarts, H.H. & Alves, M.M. (2015). Metallic nanoparticles: microbial synthesis and unique properties for biotechnological applications, bioavailability and biotransformation. *Critical Reviews in Biotechnology*, 35(1), pp.114-128.

Peterson S.W. (2000). Phylogenetic relationships in *Aspergillus* based on rDNA sequence analysis. In: Samson RA, Pitt

Peterson, B.K., Weber, J.N., Kay, E.H., Fisher, H.S. & Hoekstra, H.E. (2012). Double digest RADseq: an inexpensive method for de novo SNP discovery and genotyping in model and non-model species. *PloS one*, 7(5), p.e37135.

Peterson, S.W. (2008). Phylogenetic analysis of *Aspergillus* species using DNA sequences from four loci. *Mycologia*, 100(2), pp.205-226.

Peterson, S.W., Vega, F.E., Posada, F. & Nagai, C. (2005). *Penicillium coffeae*, a new endophytic species isolated from a coffee plant and its phylogenetic relationship to P. fellutanum, P. thiersii and P. brocae based on parsimony analysis of multilocus DNA sequences. *Mycologia*, 97(3), pp.659-666.

Pettigrew C.A., Johanson, B.N. (1996) Microbiology of solid waste. CRC Press Inc, Florida, pp 71–104

Pinto, A.C., Palomar, T., Alves, L.C., da Silva, S.H.M., Monteiro, R.C., Macedo, M.F. & Vilarigues, M.G. (2019). Fungal biodeterioration of stained-glass windows in monuments from Belém do Pará (Brazil). *International Biodeterioration & Biodegradation*, 138, pp.106-113.

Piscitelli, A., Giardina, P., Lettera, V., Pezzella, C., Sannia, G. & Faraco, V. (2011). Induction and transcriptional regulation of laccases in fungi. *Current Genomics*, 12(2), pp.104-112.

Poitevin, C.G., Porsani, M.V., Poltronieri, A.S., Zawadneak, M.A.C. & Pimentel, I.C. (2018). Fungi isolated from insects in strawberry crops act as potential biological control agents of *Duponchelia fovealis* (Lepidoptera: Crambidae). *Applied Entomology and Zoology*, 53(3), pp. 323-331.

Potera, C. (2010). Diet and nutrition: the artificial food dye blues. Environ Health Perspect, v.118(10); A428. doi: 10.1289/ehp.118-a428

Pozdnyakova, N.N., Rodakiewicz-Nowak, J. & Turkovskaya, O.V. (2004). Catalytic properties of yellow laccase from *Pleurotus ostreatus* D1. *Journal of Molecular Catalysis B: Enzymatic*, 30(1), pp.19-24.

Prathapar, S. A., Jamrah, A., Ahmed, M., Al Adawi, S., Al Sidairi, S., & Al Harassi, A. (2005). Overcoming constraints in treated greywater reuse in Oman. *Desalination*, 186(1-3), 177-186.

Promputtha, I., Jeewon, R., Lumyong, S., McKenzie, E.H.C. & Hyde, K.D. (2005). Ribosomal DNA fingerprinting in the identification of non sporulating endophytes from Magnolia liliifera (Magnoliaceae). Fungal Diversity.

Radha, K.V., Regupathi, I., Arunagiri, A. & Murugesan, T. (2005). Decolorization studies of synthetic dyes using *Phanerochaete chrysosporium* and their kinetics. *Process Biochemistry*, 40(10), pp.3337-3345.

Radix, P., Léonard, M., Papantoniou, C., Roman, G., Saouter, E., Gallotti-Schmitt, S., ... & Vasseur, P. (2000). Comparison of four chronic toxicity tests using algae, bacteria, and invertebrates assessed with sixteen chemicals. *Ecotoxicology and Environmental Safety*, *47*(2), 186-194.

Rajathi, F.A.A., Parthiban, C., Kumar, V.G. & Anantharaman, P. (2012). Biosynthesis of antibacterial gold nanoparticles using brown alga, *Stoechospermum marginatum* (kützing). *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy*, 99, pp.166-173.

Ramírez-Cavazos, L.I., Junghanns, C., Ornelas-Soto, N., Cárdenas-Chávez, D.L., Hernández-Luna, C., Demarche, P., Enaud, E., García-Morales, R., Agathos, S.N.

& Parra, R. (2014). Purification and characterization of two thermostable laccases from *Pycnoporus sanguineus* and potential role in degradation of endocrine disrupting chemicals. Journal of Molecular Catalysis B: Enzymatic, 108, pp.32-42.

Ray, A.C., Eakin, R.E. (1975) Studies on the biosynthesis of aspergillin by *Aspergillus niger*. *Applied Microbiology*, 30:909–915.

Rehner, S.A. & Samuels, G.J. (1995). Molecular systematics of the Hypocreales: a teleomorph gene phylogeny & the status of their anamorphs. *Canadian Journal of Botany*, 73(S1), pp.816-823.

Renganathan, S., Thilagaraj, W. R., Miranda, L. R., Gautam, P., & Velan, M. (2006). Accumulation of acid orange 7, acid red 18 and reactive black 5 by growing Schizophyllum commune. *Bioresource technology*, *97*(16), 2189-2193.

Revankar, M.S. & Lele, S.S. (2007). Synthetic dye decolorization by white rot fungus, Ganoderma sp. WR-1. *Bioresource Technology*, 98(4), pp.775-780.

Rifal, M.A. (1969). A revision of the genus *Trichoderma*. *Mycology Papers* 116: 1-55.

Robert, A.S., János, V., Christian, F.J. (2011). Taxonomic studies on the genus *Aspergillus*- DTU Orbit. CBS-KNAW Fungal Biodiversity Centre, (2011). (Studies in Mycology). Publication Research - peer-review Book – Annual report year: (2011).

Rosales, P., Dubbelman, M., Marcos, S. & Van der Heijde, R. (2006). Crystalline lens radii of curvature from Purkinje and Scheimpflug imaging. *Journal of Vision*, 6(10), pp.5-5.

Saha, A., Mandal, P., Dasgupta, S. & Saha, D. (2008). Influence of culture media and environmental factors on mycelial growth and sporulation of Lasiodiplodia theobromae (Pat.) Griffon and Maubl. *Journal of Environmental Biology*, 29(3), p.407.

Salazar-López, M., Rostro-Alanis, M.D.J., Castillo-Zacarías, C., Parra-Guardado, A.L., Hernández-Luna, C., Iqbal, H.M. & Parra-Saldivar, R. (2017). Induced degradation of anthraquinone-based dye by laccase produced from *Pycnoporus sanguineus* (CS43). *Water, Air, & Soil Pollution*, 228(12), p.469.

Samson, R.A., Houbraken, J., Thrane, U., Frisvad, J.C. & Andersen, B. (2010). Food and indoor fungi. CBS laboratory manual series 2. Utrecht: CBS-Fungal Biodiversity Centre.

Samson, R.A., Visagie, C.M., Houbraken, J., Hong, S.B., Hubka, V., Klaassen, C.H., Perrone, G., Seifert, K.A., Susca, A., Tanney, J.B. & Varga, J. (2014). Phylogeny, identification and nomenclature of the genus *Aspergillus*. *Studies in Mycology*, 78, pp.141-173.

Samuels GJ, Lieckfeldt E, Nirenberg HI (1999). *Trichoderma asperellum*, a new species with warted conidia, & redescription *T. viride*. *Sydowia* 51: 71–88.

Sandhu, G.S., Kline, B.C., Stockman, L. & Roberts, G.D. (1995). Molecular probes for diagnosis of fungal infections. *Journal of cCinical Microbiology*, 33(11), pp.2913-2919.

Sanghi, P. Verma, S. Puri, (2011). Enzymatic formation of gold nanoparticles using *Phanerochaete chrysosporium*, *Advances in Chemical Engineering and Science*. 01 (2011) 154–162.

Saratale, R.G., Saratale, G.D., Kalyani, D.C., Chang, J.S. & Govindwar, S.P. (2009). Enhanced decolorization and biodegradation of textile azo dye Scarlet R by using developed microbial consortium-GR. *Bioresource Technology*, 100(9), pp.2493-2500.

Sari, A.A. & Tachibana, S. (2012). Correlation of ligninolytic enzymes from the newly-found species Trametes versicolor U97 with RBBR decolorization and DDT degradation. *Water, Air, & Soil Pollution*, 223(9), pp.5781-5792.

Sarkar, G., & Sadrekarimi, A. (2020). Compressibility and monotonic shearing behaviour of Toronto peat. *Engineering Geology*, 105822.

Sathishkumar, P., Balan, K., Palvannan, T., Kamala-Kannan, S., Oh, B.T. & Rodríguez-Couto, S. (2013). CLEAN–Soil, Air, *Water*, 41(7), pp.665-672.

Sayadi, S. & Ellouz, R. (1993). Screening of white rot fungi for the treatment of olive mill waste-waters. *Journal of Chemical Technology & Biotechnology*, 57(2), pp.141-146.

Schliephake, K., Mainwaring, D.E., Lonergan, G.T., Jones, I.K. & Baker, W.L. (2000). Transformation and degradation of the disazo dye Chicago Sky Blue by a purified

laccase from Pycnoporus cinnabarinus. *Enzyme and Microbial Technology*, 27(1-2), pp.100-107.

Schoch, C.L., Seifert, K.A., Huhndorf, S., Robert, V., Spouge, J.L., Levesque, C.A., Chen, W. & Fungal Barcoding Consortium, (2012). Nuclear ribosomal internal transcribed spacer (ITS) region as a universal DNA barcode marker for Fungi. *Proceedings of the National Academy of Sciences*, 109(16), pp.6241-6246.

Schwarz, P., Lortholary, O., Dromer, F. & Dannaoui, E. (2007). Carbon assimilation profiles as a tool for identification of zygomycetes. *Journal of Clinical Microbiology*, 45(5), pp.1433-1439.

Sejie, F. P., & Nadiye-Tabbiruka, M. S. (2016). Removal of methyl orange (MO) from water by adsorption onto modified local clay (kaolinite). *Physical Chemistry*, *6*(2), 39-48.

Senthilkumar, N., Aravindhan, V., Ruckmani, K. & Potheher, I.V. (2018). *Coriandrum sativum* mediated synthesis of silver nanoparticles and evaluation of their biological characteristics. *Materials Research Express*, 5(5), p.055032.

Seydametova, E., Kambol, R.B.H. & Zainol, N.B. (2011). Morphological characterization of soil Penicillium sp. strains potential producers of statins. *International Journal* of *Chemical Engineering and Application* 3(5), pp.338-342.

Shamseldin, A. & Abdelkhalek, A.A. (2015). Isolation and identification of newly effective bacterial strains exhibiting great ability of lignin and rice straw biodegradation. *International Journal* of *Current Microbiology* and *Applied* Sciences, 4(6), pp.1039-1049.

Shan T, Sun W, Lou J, Gao S, Mou Y, Zhou L. (2012). Antibacterial activity of the endophytic fungi from medicinal herb, *Macleaya cordata*. *African Journal of Biotechnology* 11: 4354–4359.

Shi, K.W., Wang, C.W. & Jiang, S.C. (2018). Quantitative microbial risk assessment of Greywater on-site reuse. *Science of the Total Environment*, 635, pp.1507-1519.

Siddiqi, K. S., & Husen, A. (2016). Fabrication of metal nanoparticles from fungi and metal salts: scope and application. *Nanoscale Research Letters*, 11(1), 98.

Silva, D.M., Batista, L.R., Rezende, E.F., Fungaro, M.H.P., Sartori, D. & Alves, E. (2011). Identification of fungi of the genus *Aspergillus* section nigri using polyphasic taxonomy. *Brazilian Journal of Microbiology*, 42(2), pp.761-773.

Silva, I.S., Menezes, C.R.D., Franciscon, E., Santos, E.D.C.D. & Durrant, L.R. (2010). Degradation of lignosulfonic and tannic acids by ligninolytic soil fungi cultivated under icroaerobic conditions. *Brazilian Archives of Biology and Technology*, 53(3), pp.693-699.

Singh, D., Zeng, J. & Chen, S. (2011). *Letters in Applied Microbiology*, 53(1), pp.120-123.

Singh, J., Dutta, T., Kim, K.H., Rawat, M., Samddar, P. & Kumar, P. (2018). Green synthesis of metals and their oxide nanoparticles: applications for environmental remediation. *Journal of Nanobiotechnology*, 16(1), p.84.

Siripireddy, B. & Mandal, B.K. (2017). Facile green synthesis of zinc oxide nanoparticles by Eucalyptus globulus and their photocatalytic and antioxidant activity. *Advanced Powder Technology*, 28(3), pp.785-797.

Sivanesan, A. (1987). Graminicolous species of Bipolaris, *Curvularia*, Drechslera, Exserohilum and their teleomorphs. CAB International.

Song, J., Zhang, F., Huang, Y., Keller, A.A., Tang, X., Zhang, W., (2018). Highly efficient bacterial removal and disinfection by magnetic barium phosphate nanoflakes with embedded iron oxide nanoparticles. *Environmental Science*: Nano, 5(6), pp.1341-1349.

Songulashvili, G., Elisashvili, V., Wasser, S.P., Nevo, E. & Hadar, Y. (2007). Basidiomycetes laccase and manganese peroxidase activity in submerged fermentation of food industry wastes. *Enzyme and Microbial Technology*, 41(1-2), pp.57-61.

Sparlinek, L., Leitner, V. & Kamm, B. (2018). Statistical optimisation of enzymatic detoxification with laccase from *Trametes versicolor* for spent sulphite liquors using a novel in-situ NMR method. *Journal of Biotechnology*, 284, pp.63-67.

STAATT (2005) Technical assistance manual: state regulatory oversight of medical waste treatment technology. Report of the state and territorial association on alternative treatment technologies (STAATT).

Stamets, P. (1993) Growing Gourmet and Medicinal Mushrooms. Ten Speed Press, Berkeley, 211-350.

Stamets, P. (2010) Comprehensive assessment of mycofiltration biotechnology to remove pathogens from urban storm water, Final Report submitted to US Environmental Protection Agency.

Stumm-Zollinger, E. and Fair, G.M. 1965. Biodegradation of steroid hormones. Res. J. Water Poll. Control, 37 (11), 1506– 1510.

Sugiura, T., Yamagishi, K., Kimura, T., Nishida, T., Kawagishi, H. & Hirai, H. (2009). Cloning and homologous expression of novel lignin peroxidase genes in the white-rot fungus Phanerochaete sordida YK-624. *Bioscience, Biotechnology, and Biochemistry*, 73(8), pp.1793-1798.

Talaat, W. I. A. W., Tahir, N. M., & Husain, M. L. (2012). Sustainable management of forest biodiversity and the present Malaysian policy and legal framework. *Journal of Sustainable Development*, 5(3), 76.

Taylor, A., Flatt, A., Beutel, M., Wolff, M., Brownson, K. & Stamets, P. (2015). Removal of Escherichia coli from synthetic stormwater using mycofiltration. *Ecological Engineering*, 78, pp.79-86.

Telke, A.A., Kadam, A.A. & Govindwar, S.P. (2015). *Bacterial enzymes and their role in decolorization of azo dyes*. In Microbial Degradation of Synthetic Dyes in Wastewaters (pp. 149-168). Springer, Cham.

Ten, L.N., Im, W.T., Kim, M.K., Kang, M.S. & Lee, S.T. (2004). Development of a plate technique for screening of polysaccharide-degrading microorganisms by using a mixture of insoluble chromogenic substrates. *Journal of Microbiological Methods*, 56(3), pp.375-382.

Thormann, M.N. (2006). Diversity and function of fungi in peatlands: a carbon cycling perspective. Canadian Journal of Soil Science, 86(Special Issue), pp.281-293.

Thurston, C.F. (1994). The structure and function of fungal laccases. *Microbiology*, 140(1), pp.19-26.

Tien, M. & Kirk, T.K. (1988). Lignin peroxidase of *Phanerochaete chrysosporium*. In Methods in enzymology (Vol. 161, pp. 238-249). Academic Press.

Toloti, A. A., & Mehrdadi, N. (2011). Wastewater treatment from antibiotics plant. *International Journal of Environmental Research*, *5*(1), 241-246.

Trupkin, S., Levin, L., Forchiassin, F. & Viale, A. (2003). Optimization of a culture medium for ligninolytic enzyme production and synthetic dye decolourization using response surface methodology. *Journal of Industrial Microbiology and Biotechnology*, 30(12), pp.682-690.

Vaithanomsat, P., Apiwatanapiwat, W., Petchoy, O. & Chedchant, J. (2010). Production of ligninolytic enzymes by white-rot fungus Datronia sp. KAPI0039 and their application for reactive dye removal. *International Journal of Chemical Engineering*, (2010).

van Bellen, S., & Larivière, V. (2020) The ecosystem of peatland research: a bibliometric analysis. *Mires and Peat*, 26, p. 30.

van Kerkhof, P., Govers, R., dos Santos, C.M.A. & Strous, G.J. (2000). Endocytosis and degradation of the growth hormone receptor are proteasome-dependent. *Journal of Biological Chemistry*, 275(3), pp.1575-1580.

Vantamuri, A.B. & Kaliwal, B.B. (2016). Purification and characterization of laccase from Marasmius species BBKAV79 and effective decolourization of selected textile dyes. 3 *Biotech*, 6(2), p.189.

Varga J, To´th B, Kocsube´ S, Farkas B, Szaka´cs G, Te´ren J, Kozakiewicz Z. (2005). Evolutionary relationships among Aspergillus terreus isolates and their relatives. *Antonie Leeuwenhoek* 88:141–150.

Veloo, R., Paramananthan, S. & Van Ranst, E. (2014). Classification of tropical lowland peats revisited: The case of Sarawak. Catena, 118, pp.179-185.

Verwer, P.E.B., Van Leeuwen, W.B., Girard, V., Monnin, V., van Belkum, A., Staab, J.F., Verbrugh, H.A., Bakker-Woudenberg, I.A.J.M. & van de Sande, W.W.J. (2014). Discrimination of Aspergillus lentulus from *Aspergillus fumigatus* by Raman spectroscopy and MALDI-TOF MS. European Journal of Clinical Microbiology & Infectious Diseases, 33(2), pp.245-251.

Vilgalys, R. & Hester, M. (1990). Rapid genetic identification and mapping of enzymatically amplified ribosomal DNA from several *Cryptococcus* species. *Journal of Bacteriology*, 172(8), pp.4238-4246.

Viswanath, B., Rajesh, B., Janardhan, A., Kumar, A.P. & Narasimha, G. (2014). Fungal laccases and their applications in bioremediation. *Enzyme Research*, (2014).

Vlysidis, A., Binns, M., Webb, C. & Theodoropoulos, C. (2011). A techno-economic analysis of biodiesel biorefineries: assessment of integrated designs for the co-production of fuels and chemicals. *Energy*, 36(8), pp.4671-4683.

Walsh, F. (2013). Investigating antibiotic resistance in non-clinical environments. *Frontiers in Microbiology*, 4, p.19.

Wang, K., Huang, K. & Jiang, G. (2018). Enhanced removal of aqueous acetaminophen by a laccase-catalyzed oxidative coupling reaction under a dual-pH optimization strategy. *Science of The Total Environment*, 616, pp.1270-1278.

Wang, L., Hu, C. & Shao, L. (2017). The antimicrobial activity of nanoparticles: present situation and prospects for the future. *International Journal of Nanomedicine*, 12, p.1227.

Wang, M.X., Zhang, Q.L. & Yao, S.J. (2015). A novel biosorbent formed of marine-derived Penicillium janthinellum mycelial pellets for removing dyes from dye-containing wastewater. *Chemical Engineering Journal*, 259, pp.837-844.

Wang, W., Anderson, C.F., Wang, Z., Wu, W., Cui, H. & Liu, C.J. (2017). Peptide-templated noble metal catalysts: syntheses and applications. *Chemical Science*, 8(5), pp.3310-3324.

Warman, P.R. (1999). Evaluation of seed germination and growth tests for assessing compost maturity. *Compost Science & Utilization*, 7(3), pp.33-37.

Watanabe, T. (2002). *Pictorial atlas of soil and seed fungi*; Morphologies of cultured fungi and key to species, 2nd Edition. CRC Press Boca Raton London New York Washington, D.C.

Wesenberg, D., Kyriakides, I. & Agathos, S.N. (2003). White-rot fungi and their enzymes for the treatment of industrial dye effluents. *Biotechnology Advances*, 22(1-2), pp.161-187.

White TJ, Bruns TD, Lee S, & Taylor J. (1990). Amplification and direct sequencing of fungal ribosomal RNA genes for phylogenetics. In: Innis MA, Gelfand DH, Sninsky JJ, White TJ eds. PCR protocols, a guide to methods and applications. San Diego, California: Academic Press. p315-322

Whittaker, R.H. (1969). New concepts of kingdoms of organisms. *Science*, 163(3863), pp.150-160.

Wilson, K., Walker, J. (2000). *Practical Biochemistry: Principles and Techniques*. Cambridge University Press

Woese, C.R. & Fox, G.E. (1977). Phylogenetic structure of the prokaryotic domain: the primary kingdoms. *Proceedings of the National Academy of Sciences*, 74(11), pp.5088-5090.

Won, E.J., Shin, J.H., Lim, S.C., Shin, M.G., Suh, S.P. & Ryang, D.W. (2012). Molecular identification of Schizophyllum commune as a cause of allergic fungal sinusitis. *Annals of Laboratory Medicine*, 32(5), pp.375-379.

Wu, L., Luo, Y.P., Wan, J.B. & Li, S.G. (2006). Use of Yarrowia lipolytica for the treatment of oil/grease wastewater. *Research of Environmental Science (China)*, 19(5), pp.122-125.

Wurochekke A. (2017). Ph.D Thesis, Faculty of Civil and Environmental Eng. Universiti Tun Hussein Onn Malaysia (UTHM). Johor, Malaysia.

Xiao, Y., Tu, X., Wang, J., Zhang, M., Cheng, Q., Zeng, W. & Shi, Y. (2003). Purification, molecular characterization and reactivity with aromatic compounds of a laccase from basidiomycete Trametes sp. strain AH28-2. *Applied Microbiology and Biotechnology*, 60(6), pp.700-707.

Yamane T. (1989). Enzyme technology for the lipid industry. An engineering overview. *Journal of the American Oil Chemists' Society* 64: 1657–1662.

Yashni, G., Al-Gheethi, A., Mohamed, R., Arifin, S.N.H. and Salleh, S.N.A.M. (2020). Photodegradation of basic red 51 in hair dye greywater by zinc oxide nanoparticles using central composite design. *Reaction Kinetics Mechanisms and Catalysis*, in press.

Yashni, G., Al-Gheethi, A.A., Mohamed, R.M.S.R., Arifin, S.N.H. & Hashim, N.H. (2019). Synthesis of nanoparticles using biological entities: an approach toward biological routes. *Desalination Water Treatment*, 169, pp.152-165.

Yasmeen, Q., Asgher, M., Sheikh, M.A. & Nawaz, H. (2013). Optimization of ligninolytic enzymes production through response surface methodology. *Bioresources*, 8(1), pp.944-968.

Yuan ZL, Rao LB, Chen YC, Zhang CL, Wu YG. (2011). From pattern to process: species and functional diversity in fungal endophytes of Abies beshanzuensis. *Fungal Biology* 115:197–213.

Zdarta, J., Antecka, K., Frankowski, R., Zgoła-Grześkowiak, A., Ehrlich, H. & Jesionowski, T. (2018). The effect of operational parameters on the biodegradation of bisphenols by Trametes versicolor laccase immobilized on Hippospongia communis spongin scaffolds. *Science of The Total Environment*, 615, pp.784-795.

Zhang, F. (1997). The treatment of coloured effluents with wood rotting fungi. Ph.D. Thesis, University of Leeds, Leeds, UK.

Zhang, H., Tang, Y., Ruan, C. & Bai, X. (2016). Bioactive Secondary Metabolites from the Endophytic Aspergillus Genus. *Records of Natural Products*, 10(1).

Zhang, H., Zhang, S., He, F., Qin, X., Zhang, X. & Yang, Y. (2016). Characterization of a manganese peroxidase from white-rot fungus *Trametes* sp. 48424 with strong ability of degrading different types of dyes & polycyclic aromatic hydrocarbons. *Journal of Hazardous Materials*, 320, pp.265-277.

Zhang, L., Jiang, Y., Ding, Y., Daskalakis, N., Jeuken, L., Povey, M., O'Neill, A.J. & York, D.W. (2010). Mechanistic investigation into antibacterial behaviour of suspensions of ZnO nanoparticles against *E. coli*. *Journal of Nanoparticle Research*, 12(5), pp.1625-1636.

Zimbardi, A.L., Camargo, P.F., Carli, S., Aquino Neto, S., Meleiro, L.P., Rosa, J.C., De Andrade, A.R., Jorge, J.A. & Furriel, R.P. (2016). A high redox potential laccase from *Pycnoporus sanguineus* RP15: potential application for dye decolorization. *International Journal of Molecular Sciences*, 17(5), p.672.

Zucconi, F., Monaco, A., Forte, M. De-Bertoldi, M. (1985). Elsevier Applied Science Publishers, London, pp. 73–86.