i-SPiKE 2023

INTERNATIONAL EXHIBITION & SYMPOSIUM ON PRODUCTIVITY, INNOVATION, KNOWLEDGE & EDUCATION

"Optimizing Innovation in Knowledge, Education and Design"

EXTENDED ABSTRACT

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Assalamualaikum warahmatullahi wabarakatuh,

First and foremost, I would like to express my gratitude to the organizing committee of i-Spike 2023 for their tremendous efforts in bringing this online competition a reality . I must extend my congratulations to the committee for successfully delivering on their promise to make i-Spike 2023 a meaningful event for academics worldwide.

The theme for this event, 'Optimizing Innovation in Knowledge, Education, and Design,' is both timely and highly relevant in today's world, especially at the tertiary level. Innovation plays a central role in our daily lives, offering new solutions for products, processes, and services By adopting a strategic approach to 'Optimizing Innovation in Knowledge, Education, and Design,' we have the potential to enhance support for learners and educators, while also expanding opportunities for learner engagement, interactivity, and access to education.

I am awed by the magnitude and multitude of participants in this competition. I am also confident that all the innovations presented have provided valuable insights into the significance of innovative and advanced teaching materials in promoting sustainable development for the betterment of teaching and learning. Hopefully, this will mark the beginning of a long series of i-Spike events in the future.

It is also my hope that you find i-Spike 2023 to be an excellent platform for learning, sharing, and collaboration. Once again, I want to thank all the committee members of i-Spike 2023 for their hard work in making this event a reality I would also like to extend my congratulations to all the winners, and I hope that each of you will successfully achieve your intended goals through your participation in this competition.

Professor Dr. Roshima Haji Said
RECTOR
UiTM KEDAH BRANCH

WELCOME MESSAGE (i-SPiKE 2023 CHAIR)

We are looking forward to welcoming you to the 3rd International Exhibition & Symposium on Productivity, Innovation, Knowledge, and Education 2023 (i-SPiKE 2023). Your presence here is a clear, crystal-clear testimony to the importance you place on the research and innovation arena. The theme of this year's Innovation is "*Optimizing Innovation in Knowledge, Education, & Design*". We believe that the presentations by the distinguished innovators will contribute immensely to a deeper understanding of the current issues in relation to the theme.

i-SPiKE 2023 offers a platform for nurturing the next generation of innovators and fostering cutting-edge innovations at the crossroads of collaboration, creativity, and enthusiasm. We enthusiastically welcome junior and young inventors from schools and universities, as well as local and foreign academicians and industry professionals, to showcase their innovative products and engage in knowledge sharing. All submissions have been rigorously evaluated by expert juries comprising professionals from both industry and academia.

On behalf of the conference organisers, I would like to extend our sincere thanks for your participation, and we hope you enjoy the event. A special note of appreciation goes out to all the committee members of i-SPiKE 2023; your dedication and hard work are greatly appreciated.

Dr. Junaida Ismail
Chair
3rdInternational Exhibition & Symposium Productivity, Innovation, Knowledge, and Education 2023 (i-SPiKE 2023)

MYCELIA BIO-P

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ABSTRACT
Waste disposal in Malaysia is not as efficient in terms of the collection time and the degradation method. Increasing population size also has contributed to the increase in plastic waste like food wrappers, drinking straws, plastic bottles, Tetra Pak covers which abundantly found in schools. Hence, MYCELLIA BIO-P is an innovation to address the issue of waste disposal in schools and in landfills in general thus the project aims in shortening the decomposition time of plastic waste in school by applying mycoremediation method. With mycelia of mushroom from Pleurotaceae family as active ingredient, recreated paper pulp serves as a medium to initiate the growth of mycelium, colonising the plastic waste and decomposing them. The result shows that mycelia of Pleurotaceae sp. shows degrading effects on plastic waste possibly due to the enzymatic degradation thus contributing to shortening the rate of decomposition of plastics waste from the original period.

Keyword: mycoremediation, enzymatic degradation, mycelia, Pleurotaceae family

INTRODUCTION

Malaysia has been the world's top importer of plastic garbage since 2017 and monitors global trends in both the overall output of plastic waste and the use of single-use plastics (Hui *et a*l. 2021). The nation's waste management system is faced with a number of significant issues that arise as a result of these factors. In this review, the production and handling of plastic trash in Malaysia are described in detail, along with options for landfilling, recycling, and incineration. According to WWF Australia (2021) and Paul Delaney (2013) in his writing in Eco Aware,General, plastic bottles take up to 450 years to fully degrade, whereas plastic bags take between 500 and 1000 years. Tetra covers, on the other hand, take 5 years to completely dissolve while plastic straws take up to 200 years to degrade. In our school, it is observed that most plastic waste consists of plastic bags, straws, plastic bottles, and plastic containers for food packaging. Hence, we come out with a problem statement that the red zone is being overrun by plastic debris, especially in schools which can affect the environment and student health in the long term. Hence, our project is conducted with the aim: - 1) to come up with a fix for the plastic decomposition issue in school; 2) discover a greener method of discarding plastics; and 3) to apply mycoremediation to different types of plastic disposal in school.

SIGNIFICANCE OF STUDY

This study presents a greener technique that Malaysia might use to dispose specifically waste disposal firms should learn about the notion of mycoremediation rather than use the conventional techniques that might pollute the environment. As the mushrooms produced might be a source of income for the school as well as food for the families, the project would also be beneficial to households and schools in that it would allow them to dispose of their trash in a sustainable and cost-effective manner.

LIMITATION OF STUDY

This study might have several potential limitations. The study conducted is limited to the type of plastic waste in school, focusing on several types of waste materials. Next, it is conducted on a small scale involving the waste found in schools. Thus, the results might vary in the experiment that we try on. In addition, there is little research that could be reviewed in Malaysia which limits the support on our project. However, researches from other serve to guide and support to our project though the result might vary due to different climates in Malaysia compared to other countries.

DEFINITION OF TERMS

Mycoremediation serves a new wave of cutting-edge technology in this era that incorporates fungi in nursing environments damaged by toxins. (Mishra M. & Srivastava D.(2020))

Enzymatic degradation is a process where enzymes break down materials in this case, plastic polymers in a way it degrades the polymer chains to smaller monomers. Focusing on the study, enzymatic degradation of plastic polymers involves several enzymes such as esterase, lipase, cutinase, protease, peroxidase (Jyoti *et al.* 2021) are also found in the edible mushroom from Pleurotaceae family or known as oyster mushroom (Shakuntala Ghorai (2022)).

Mycelia is known as part of a fungus grows vegetatively and colonises the substrates, breaking them down to gain nutrition for developing primordium and next its fruiting body. Found in the mushroom spawn, It grows in both solid-grown and submerged cultures. (Shabiha N.H. & Debajit T.,(2020)).

***Pleurotaceae* family**, known as oyster mushroom;is the easiest and least expensive commercial mushroom to grow for they are well known for conversion of crop residues to food protein and for recycling of agricultural wastes (Banik and Nandi R ,2004))

METHODOLOGY

1) *Experiment on decomposition rate of plastic waste by different species of mushroom from the same Pleurotaceae family: Pleurotus citronipileatus (Golden oyster mushroom), Pleurotus ostreatus (oyster mushroom), and Pleurotus flabellatus (Pink oyster mushroom)*

Four different plastic wastes - plastic straw, plastic bottle, plastic wrapper, and Tetra Pak cover; are used in this experiment in which the samples collected from school's area are shredded and

put into four different beakers for each type of plastic waste. Each material is fixed on the initial mass for each mushroom species as shown in table in next chapter. The medium with mushroom spawn is added to each beaker and let to grow for 15 days. The final mass of samples is weighed and recorded and the difference of mass is calculated to find the decomposition rate for each sample in each species tested.

2) *Product assembly of paper pulp incorporating the mushroom spawn as the active ingredient*

Our product uses mycelia as active ingredient, wood dust, lime, paddy bran, egg cartons and water. The paper pulp is recreated with the addition of mushroom spawn where egg cartons are shredded and mixed in hot water to make paper pulp. The paper pulp is combined with wood dust and added with paddy bran and lime following the ratio of 100:10:1 (Awang Z.et al (2021)) and added water. Paper pulp is moulded to the desired products, in this case disposable cup sleeves and disposable cup coaster. The moulded paper pulp is left to dry in 24 hours to supress mycelia germination.

DATA ANALYSIS

The data is recorded based on the experiment conducted as stated in procedure in the previous chapter. To observe the decomposition rate of the samples, differences in mass of samples were recorded and the rate of decomposition is calculated using formula: *difference in mass/15 days of experiment duration.* Samples are tested using different species of mushroom from the same *Pleurotaceae* family - *Pleurotus citronipileatus*, *Pleurotus ostreatus*, and *Pleurotus flabellatus*. The results are as shown in the table below.

Sample	Initial mass (g)	Final mass (g)	Difference in mass (g)	Rate of decomposition (g/day)
Plastic straw	5.00	4.50	0.50	0.033
Tetra Pak covers	10.00	5.10	4.90	0.327
Plastic bottle	8.00	7.61	0.39	0.026
Plastic wrapper	5.60	5.41	0.19	0.013

Plastic Decomposition rate by *Pleurotus citronipileatus* (Golden oyster mushroom)

Sample	Initial mass (g)	Final mass (g)	Difference in mass (g)	Rate of decomposition (g/day)
Plastic straw	5.00	4.91	0.09	0.006
Tetra Pak covers	10.00	8.79	1.21	0.081
Plastic bottle	8.00	7.24	0.76	0.051
Plastic wrapper	5.60	5.21	0.39	0.026

Plastic Decomposition rate by *Pleurotus ostreatus* (oyster mushroom)

Sample	Initial mass (g)	Final mass (g)	Difference in mass (g)	Rate of decomposition (g/day)
Plastic straw	5.00	4.16	0.84	0.056
Tetra Pak covers	10.00	8.10	1.9	0.127
Plastic bottle	8.00	6.95	1.05	0.07
Plastic wrapper	5.60	5.05	0.55	0.037

Plastic Decomposition rate by *Pleurotus flabellatus* (Pink oyster mushroom)

It is also found that there are changes in surface structure of the samples as observed in microscope where the mycelia are capable of colonising plastic waste surfaces as shown in diagram below and increase of pores developed on the samples surface as shown in diagram.

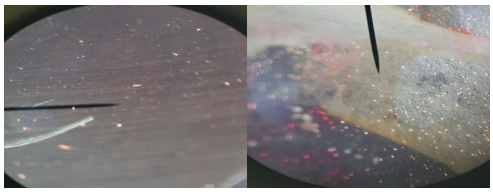

Diagram shows that more pores developed on sample after 15 days with mycelia colonising the surface(right) compared to control(left).

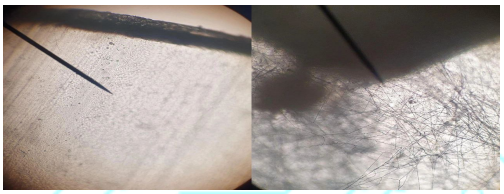

Diagram shows mycelia colonising the plastic waste surface(right) compared to control (left).

DISCUSSION

Plastic is mostly synthetic polymers made by chains of carbon atoms with hydrogen, oxygen, nitrogen, sulphur built around the carbon chains. It takes various enzymes to break down the complex chains in different polymers such as esterase, laccase, peroxidase, cutinase, lipase, and PETase. The degradation of the polymers by the enzymes causes breakdown of polymers chain through assimilation in the cells and releases substances that are more environmentally friendly (Jyoti *et.al,* 2021). These enzymes are potentially found in mushrooms of *Pleurotaceae* family that prone to naturally degrade plastic polymers in the samples with the enzymes produced throughout their growth to form fruiting bodies. Research by Shakuntala Ghorai (2022), Téllez-Téllez, M., and Diaz-Godinez, G. (2019) and El Enshasy,H. et al (2019) shows that different enzymatic activities as biocatalyst occur in mushrooms of Pleurotaceae family includes the laccase, versatile peroxidase, manganese peroxidase cellulase, invertase, xylanase,

protease, esterase, peptidase, glycosyl hydrolases, oxidases and lipases. This is in line with the research stated that the same enzymes found in the mushrooms are responsible for degrading the polymers found in samples of plastic wastes we used in our project such as Polyethylene and Polypropylene in snack wrappers, plastic straw and plastic bottles as well as the cover for tetra Pak packages. These polymers are known to take very long time to degrade and decompose hence the presence of enzymes in the Pleurotaceae family as in the project - *Pleurotus flabellatus, Pleurotus citronipileatus* and *Pleurotus ostreatus* help to increase the rate of decomposition of the materials as shown in previous chapter a few times faster compared to original period.

Thus, the product created incorporates the method of mycoremediation in disposal and decomposition of plastic waste in our school and in Malaysia in general. The presence of nutrition from the food waste in landfills as well the dampness of the environment would be the key for activating the mycelium in the paper pulp products to grow and colonise the wastes and digest them better, shorten the original period of waste decomposition. As the paper pulp product absorbs the moisture from the environment as in our target place, the landfills, the mushroom spawn could continue to grow the mycelium and colonise its surrounding and grow the fruiting bodies that is the mushroom. These mushrooms on other hand, provided the waste management is properly conducted it could be a source of economy as the mushrooms are edible. Hence, we believe the product would help cater the waste disposal issue through mycoremediation to generate less pollutants and promote a greener way of synthesis of nano-particles in our environment (Ghorai, S., 2022).

CONCLUSION

All in all, it is proven analytically that the mycelia are capable of degrading plastic waste using the biocatalytic enzymes produced by the mushrooms specifically the Pleurotaceae family in a way it degrades the polymers in the plastic waste materials into monomers and next to products that are less toxic to the environment. Apart from serving a market potential as edible mushrooms that is rich in nutrients, the mushrooms serve as the active ingredient in our product with its capability of breaking down complex plastic materials that usually take a very long time to degrade to a shorter degradation time which could be a promising method to cater the issue on plastic waste disposal and its degrading period.

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