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Biodegradable Film From *Pleurotus sajor-caju* Waste

Hazwani Husain*, Ahmad Yazid Rahman, Norshazila Senawi, Yamunasri A/P Kuthiah, Syaliyana Khairudin, Thivya A/P Nadarajah

Department of Agrotechnology and Bio-industri, Politeknik Nilai, 71760 Nilai, Negeri Sembilan

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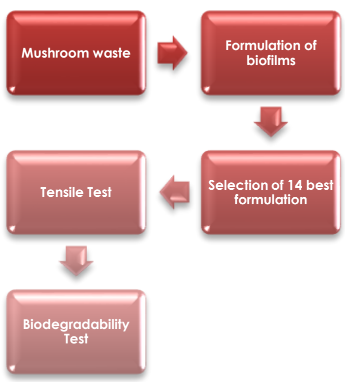
*Corresponding author
hazwanihusain@polinilai.edu.my

Graphical abstract



Abstract

The accumulation of waste is a growing environmental concern on the issues all around the world. One green option is to convert waste into valuable materials. This study aims to recycle mushroom waste from *Pleurotus sajor-caju* from '*Rumah Cendawan*', Politeknik Nilai to develop biofilm which has the potential to be molded into a variety of products. Forty two formulations have been molded and 14 best formulations have been tested. The tensile strengths of these 14 biofilms have been determined by using Shimadzu Universal Testing Machine and the biodegradability characteristics of the films have been tested. In a conclusion, biodegradable films from *Pleurotus sajor-caju* waste can be developed as a better alternative to the existing plastics in the market.

Keywords: *Pleurotus sajor-caju*, waste, biofilm, tensile strength and biodegradable

1.0 INTRODUCTION

The durability properties which make plastics ideal for many applications can lead to waste disposal problems in the case of traditional petroleum-derived plastics, as these materials are not readily biodegradable. Other than that, petroleum-derived plastics are resistant to microbial degradation thus will accumulate in the environment [1]. For instance, it can take up to one hundred years to degrade only a few grams of plastic (such as polyethylene) under normal environmental conditions. Because plastics cannot be degraded by natural processes in a short period of time, they are left as plastic waste", causing environmental problems [2]. Since last decades, many attempts have been focused on grafting or blending plastic materials with cheap and biodegradable natural biopolymers, such as starch, cellulose and chitin to create new materials with desired properties [3].

In the mushroom industry, a massive amount of the biowaste has been accumulated during mushroom production and harvesting. Mushroom waste is mainly consists of stalks and mushrooms of irregular dimensions and shapes. The amount of biowaste obtained can be up to 50,000 metric tons per year [4]. Wastes leftover from mushroom farms can be an alternative free source of chitosan materials other than using the shellfish waste [5]. Mushroom waste accumulated from '*Rumah Cendawan*', *Politeknik Nilai* mainly consists of stalks and irregular shapes of mushroom.

This research had been done to determine the biodegradability and the tensile strength of biofilm made from *Pleurotus Sajor-caju* waste as a potential plastic replacer.

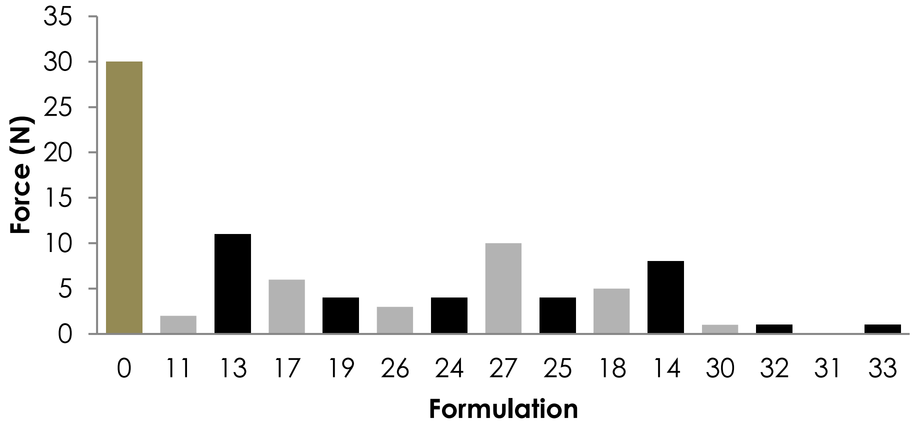


Figure 1 The effects of Force (N) on a variety of formulation of biofilms.

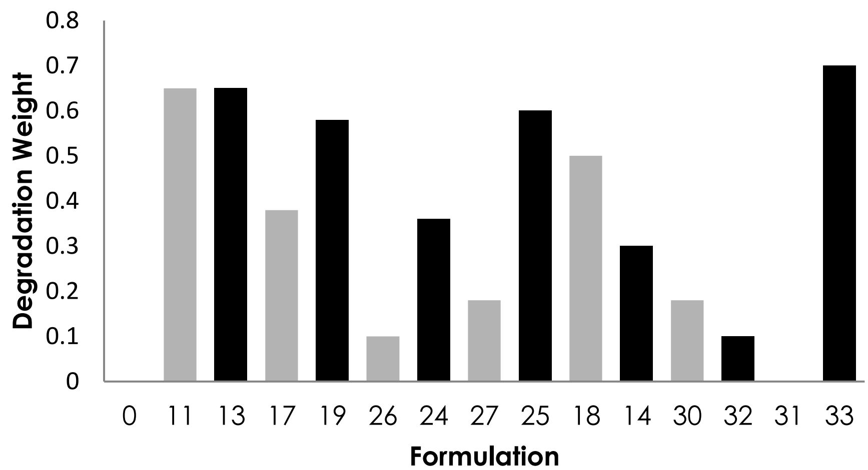


Figure 2 Biodegradability data of various formulations of biofilms.

2.0 METHODOLOGY

2.1 Materials

Rotten mushrooms of *Pleurotus sajor caju* were obtained from *Rumah Cendawan Politeknik Nilai*, Negeri Sembilan and all chemicals used in producing the biodegradable films as well as for analytical procedures were of analytical grade or the highest purity available. Chemicals used were sodium hydroxide, hydrochloric acid, acetic acid, starch powder and glycerine.

2.2 Preparation of Mushroom Powder

The rotten mushrooms were washed with clean water to remove dirt or other undesirable materials before drying at room temperature. The dried mushrooms were then pulverized into powder in a dry blender before sieving and storing at room temperature for further use.

2.3 Preparation of Biodegradable Films

Sodium hydroxide, hydrochloric acid, acetic acid, starch powder, and glycerine were placed inside a beaker simultaneously. Mushroom powder was then added to mushroom-based films. The mixture was stirred and let to boil until it starts to become paste. After boiling, the mixture was taken off the heat, poured into a mold and spread out into sheets.

2.4 Measurement of Biodegradability

Biodegradability test was done based on the soil burial method. Samples of 2.5 cm x 2.5 cm sizes were buried in soil for 3 days. After 3 days, the samples were observed and buried again for the next 3 days. The samples were observed for the second time. Percentage of weight loss due to degradation was determined by subtracting the weight of the sample taken out on a particular day (that is, after every 3 days) from the initial weight that is, the weight of the sample at the start of the degradation study each time.

2.5 Measurement of Tensile Strength

A tensile test was used to compare the strength of samples by finding the force needed to break the plastic. For measuring the tensile strength of the films, a universal testing machine (Shimadzu Precision Universal Tester Autograph AG-X Series) was employed using the ASTM D882-91 Standard method [6]. The biodegradable films and plastic samples 9formulation 0) were cut into1.5cm x 5cm dumbbell shapes.

3.0 RESULTS AND DISCUSSION

3.1 Tensile Strength Test

Figure 1 shows fourteen formulations being tested. Formulation 13 was the best formulation of biofilm based on the tensile strength test results. The formulation 13 could stand up to 11 N force compare to other formulations. The maximum tensile strength of the starch and mushroom biofilms is still better than those of starch-based films in formulation number 27.

3.2 Film Biodegradability

Film biodegradability was tested by using soil burial degradation test (refer Figure 2). Fourteen biofilms showed a continuous decrease in weight. This weight loss is due to the invasion of microorganisms into the substrate. Microorganisms feeding upon the substrates increase the percentage of weight loss [7]. Formulation number 13 shows a similar degradation time as starch-based biofilm.

Biodegradable chitin and chitosan can strengthen recycled paper and increase the environmental friendliness of packaging and other products. Chitosan is already applied in the manufacture of paper because chitosan molecules greatly resemble those of cellulose which is the main constituents of plants cell walls [8]. Extraction of chitin and chitosan from different species of mushrooms has been illustrated in few of publications [9, 10, 11] and *Pleurotus sajor-caju* was shown to produce the highest biomass yield compared to that of other species [12].

4.0 CONCLUSIONS

In conclusion, *Pleurotus sajor caju* waste has the potential to become a new material for making plastic. More study should be conducted to enhance the durability of the biodegradable film.

Acknowledgement

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