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BY PRODUCT EXCHANGE OF SEAWEED SOLID WASTE FOR MUSHROOMS MEDIA

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Abstract

A laboratory experiment on utilization of seaweed-containing solid wastes as media for growing mushrooms was conducted by researchers from the Institute for Environmental Technology. The solid wastes were obtained from PT. Agarindo Bogatama, a food industry which produces jelly powder processed from seaweed of Gracilaria. The company generates 60 tones of solid wastes of seaweed per-day that contained 70% of water content. The solid media was used to grow Auricularia polytricha, Pleurotus astreatus, and Ganoderma lucidum. Some mixed media were prepared with the percentage ratio of sawdust to solid waste as 0, 25, 50, 75, and 100. After sterilization the media were planted with mushrooms and then were kept in incubator. After 28-day the basidiomas of G. lucidum was developed while P. astreatus appeared after 36-day of incubation. Both were grown on 100% seaweed media (using 100% sawdust media as a control). This very early results indicated that solid waste of seaweeds have an additional value which can be used as media for mushrooms plantation. Implementation waste to product as a part of cleaner production approach should be disseminated to the industries, especially SMEs like PT. Agarindo Bogatama, who are concern to the environment.

Keywords: Byproduct exchange, seaweed solid waste, mushrooms

1. BACKGROUND

In Indonesia seaweed, a low level sea-plant (benthic sea algae) and lives at the base of the sea, is recognized with a variety of names such as "agar-agar" or "ganggang". Seaweed is unintentionally used in daily live such as for foods, cosmetics, toothpastes, shampoos, drag capsules, fragrant agents, and also colouring materials for textile, ceramic, film and pharmacy industries. The main component of it is also commonly used for iodine-containing prescriptions, alginate, jelly powder and "karaginan" industries.

Indonesian seas contain prominent diversity of seaweed. Nevertheless, so far only five types from the genus of *Gelidium, Gelidiella, Hypnea, Eucheuma*, and *Gracilaria* that are valuable for export-trade purposes. Two of them, i.e. *Eucheuma* and *Gracilaria* have been cultured by community (Soegiarto, 1968).

Seaweed from the genus of *Gracilaria* has been used as a raw material for jelly powder production (Chapman, 1949; Soegiarto and Sulistijo, 1981)). During the process of jelly powder making, both solid and liquid wastes are generated. The solid waste represented the biomass of the seaweed. One of big companies, PT Agarindo Bogatama, that is located at Pasar Kemis, Tangerang, produces jelly powder from the seaweed. The amount of solid wastes generated is 60 tones per day with the water content of 70%. Examination on a field, which is devoted for purging the solid wastes revealed that several farmers have attempted to utilize them as media for growing vegetables and demonstrated good results. Based on such an experience then a laboratory scale study was conducted in order to look for possibility to use the seaweed wastes for mushrooms media.

According to Chang (1978), usually, the C/N ratio of medium for wood mushroom cultivation is about 11. The chemical characteristics of solid seaweed wastes based on laboratory analyses were as follows: Carbon organic = 68013,32 mg/kg; Nitrogen Kjeldahl= 6612,77 mg/kg; and Chloride = 3936,17 mg/kg. The composition resemblance the value stated by Chang (1978). Thus, that solid wastes is considered to be suitable for wood mushroom medium. This research was aimed at studying the utilization of solid waste generated from seaweed processing as medium for mushroom cultivation.

2. MATERIALS AND METHODS

This research was conducted in the laboratory of the Institute for Environmental Technology – BPPT, which is located in Puspiptek Serpong, during March 2003. Besides the seaweed solid wastes a variety of additional materials (sawdust, chaff, dolomite, and sugar) have been used to mix with the solid wastes. Then three types of mushrooms, Judae ear (*Auricularia polytricha*), White oyster (*Pleurotus astreatus*) and Ling Zhi/Red reishi (*Ganoderma lucidum*), which were obtained from Bogor Agricultural Institute (IPB), Indonesia Institute of Sciences (LIPI) and a fungi producer respectively, were used during this study.

This research incorporated two variables: mushroom media and mushroom types. The mushroom media variable was consisted of five-level representing a mixture between sawdust and crushed seaweed wastes with: 0, 25, 50, 75 and 100 proportions (Table 1). Here 100% sawdust is considered as control. They were then placed in plastic bags of area 15 x 22 cm^2.

Table 1. Mushroom media treatment

Treatment (sawdust + crushed seaweed wastes)		Media Code	Replication (*bag-log*)
Sawdust (kg)	Crushed seaweed wastes (kg)		
0	100	M1	10
25	75	M2	10
50	50	M3	10
75	25	M4	10
100	0	M5	10

3. RESULTS

Inoculation and incubation of mushroom seeds

The sterilized media that were planted with mushroom seeds of the aforementioned types (and placed in incubator) demonstrated the growth of mycelia started from the day-5 particularly on the media that were mixed with seaweed wastes. On the same day none of the mycelia growths were detected in the control (without seaweed wastes). However, an important drawback for media that composed of seaweed wastes was contamination by other fungi. It was suspected the step for sterilization was not optimal. Besides, the high content of C and N in the seaweed wastes favoured the growth of other microbes.

Incubation in the Kumbung

When the bag-logs that have shown the emerging of mycelia were transferred to kumbung mushroom, after 28-day the basidiomas of Ling Zhi mushroom started to develop on the medium containing 100% seaweed waste and followed up by White oyster mushroom on day-36. Unlike to the White oyster mushroom that also developed the basidiomas on day-36 when grown on medium containing 100% sawdust the Ling Zhi mushroom developed on week-10 if grown on similar medium. Development of Mushroom's Basidiomas White oyster mushroom (Pleurotus ostreatus)

The development of White oyster mushroom's basidiomas was identified in M1 (100% seaweed) and M5 (100% sawdust) media after week-9 of inoculation. Similar development was also detected on M2 and M4. The only M3 medium did not show the development of basidiomas. Among the four media that showed the development of basidiomas the M1 medium was the fastest followed by M5, M4 and M2 respectively (Figure 1).

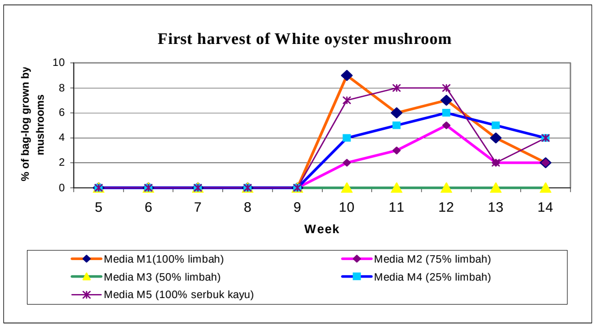

Figure 1. White oyster mushroom productions on M1, M2, M4 and M5 media.

From the phenotype perspectives, the basidiomas development of White oyster mushroom grown on M1 and M5 can be differentiated. The basidiomas developed on M5 wider than M1 as such the weight of M5's basidiomas was heavier accordingly (Figure 2).

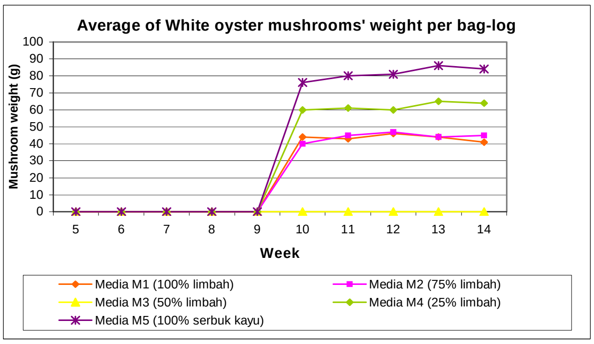

Figure 2. Average of Oyster fungi per bag log on M1, M2, M4 and M5 media.

White oyster mushroom (*Pleurotus ostreatus*) is one of potential fungi that can be developed in Indonesia. This mushroom has great adaptability to tropical conditions and high nutrition contents, such as protein, mineral, and vitamin (FAO, 1972; Gunawan, 1992). Cultivation White oyster mushroom by using sawdust media is relatively new technology (Zadrazil and Kurtzman, 1982) and in this study has been used for comparison purposes.

Ling Zhi mushroom (Ganoderma lucidum)

The development of basidiomas of Ling Zhi mushroom was identified on week-3 after inoculation, thus faster than the development of White oyster mushroom. Similar to the White oyster mushroom, the Ling Zhi was also demonstrated development on M1, M4, and M5 (of which M1 was the fastest followed by M5 and M4, Figure 3) and not on M2 and M3. Phenotype examinations demonstrated Ling Zhi grown on M1 had smaller basidiomas than M5 (Figure 4).

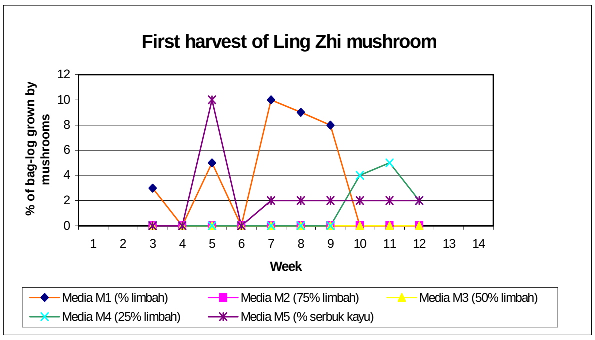

Figure 3. Ling Zhi mushroom productions on M1, M4 and M5 media.

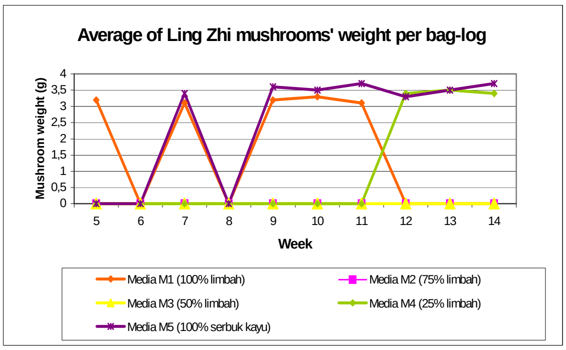

Figure 4. Average of Ling Zhi mushroom per bag log on M1, M2, M4 and M5 media.

From ecology point of view the Ling Zhi mushroom may grow individually or in groups on decaying hardwood logs and stumps (rarely on conifers). The mushroom is widely distributed on hemisphere but is more commonly found in eastern North America (Michael Kuo, 2005). .

This mushroom is one of the most important traditional Chinese medicines for stabilizing a number of body functions, which are keeping a person in good health. Many of its functions are attributed to prevention of diseases, specifically virus infections. According to the concept of Chinese medicine, Ling zhi has specific effects on the followings: Tumor, liver protection and detoxification, cardiovascular, aging prevention, neurasthenia, hypertension, diabetes, chronic bronchitis and bronchus asthma, hyper susceptibility, and beauty care (Nature Products Network Chinese, 2005).

4. CONCLUSIONS

1. The mycelia growths on media containing 100% seaweed wastes were faster than control (100% sawdust).
2. Oyter and Ling Zhi mushrooms were capable of growing on media that contained 100% seaweed waste.
3. It is necessary to optimize sterilization period to prevent contamination from other fungi
4. It is necessary to evaluate optimal environmental conditions for Judea ear mushroom growth.
5. This study demonstrated that solid wastes of seaweed processing is suitable for mushroom cultivation

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The following flowchart demonstrates steps during mushroom plantings: