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Conversion of Urban Waste into Highly Nutritious Food by *Pleurotus* Cultivation

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Abstract: *Pleurotus species are efficient lignin degraders, which can grow on different agro-residues with broad adaptability to varied agro-climatic conditions. In literature Pleurotus cultivation has been reported on tea leaves and straw of wheat, paddy, barley, maize etc. The present study was focused to evaluate the growth and yield of Pleurotus sajor-caju on the grass (Cynodon dactylon), Ashoka leaves (Polyalthia longifolia), pea pods (Pisum sativum), Municipal solid waste compost etc. Standard methodology for Pleurotus cultivation was used. However, some new parameters i.e. sterilization, nutrient supplements, incubation time and temperature for fruiting were considered. The cultivation of this species involved preparation of spawn & substrate, spawning, incubating, cropping & harvesting. Three flushes were taken upto maximum of 20 days after opening of incubated bags. Maximum yield was obtained in bags incubated for 18 days.*

Keywords: *Cynodon dactylon, Mushroom, Pleurotus sajor-caju, Polyalthia longifolia, Spawn, Urban waste.*

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I. Introduction

Every component of the biomass proves an inexhaustible resource of ligno-cellulosic energy provided we generate the capacity to trap it. There are a number of options to convert biomass into useful energy. Growing of mushrooms based on various agro-waste substrates is a valuable option which provides both rich source of protein and efficient cattle feed. Keeping in view its simplicity and cost effectiveness, this technology needs to be popularized on an extensive scale. Mushrooms are not only a rich source of protein but also a source of potassium, calcium, magnesium, iron, vitamin A, B6, B12, C and D and other biologically active compounds of medicinal value (Duyff, 2006). Mushroom culture offers a low cost labour intensive technology for the bio-conversion of straw into protein rich food, which is an important need of the country for meeting the requirements of the exponentially growing population.

Mushroom are the oldest microbial food, a delicacy of cuisine and the first solid state fermentation product. Mushrooms are saprophytic fungi, members of mostly Basidiomycota, which grow on wood, straw, farm residues and other domestic wastes rich in cellulose. Main feature that it enjoys over other microorganisms is bio-conversion of the cellulosic residues into food, and does not require any pretreatment to remove lignin. *Pleurotus* spp. (Oyster mushroom) popularly known as 'Dhingri' by farmers of India, are supposed to degrade the cellulose - lignin complex. They can be grown on straw with no added nitrogen and could prove 40-125% biologically efficient. Thus for a country like India, where ample organic residues are available, *Pleurotus* offers sufficient scope and opportunity for converting straw into high quality food rich in protein, vitamins and minerals and could serves as a means for alleviating protein and vitamin shortages of the used foods. Different media and other organic substrates like tea leaves, paddy/ wheat straw etc. have been used for cultivation of mushrooms (Gibriel et al., 1996; Garg, 2014; Upadhyay et al., 1996). However, no significant effort has been made to use agro-waste like grass, tree leaves, municipal waste, vegetable peels etc., which are available in huge quantities and is otherwise burnt in open and contribute to rising air pollution. The present study was undertaken to utilize different agro-wastes as substrate for the cultivation of *Pleurotus sajor-caju*.

II. Methodology

Urban waste i.e. dry grass, tree leaves, pea pods were collected from different fields whereas municipal waste was purchased from a solid waste compost plant (MSW Solutions, Bawana, Delhi). Standard techniques i.e. hot water treatment, formalin treatment and pasteurization were used to sterilize the substrates. Spawn was obtained from Horticulture Research Centre, Janakpuri, Delhi. Pure culture of *Pleurotus sajor-caju* was prepared on Potato-dextrose agar (PDA) medium. PDA was boiled with water for 15 minutes, taken in conical

flasks and autoclaved. Mycelium was inoculated in the PDA medium under laminar flow in test tube slants, incubated at 22-27˚C. Appropriate cultures on slants and petriplates were maintained throughout. Growth of mycelium was observed on PDA surface in 4 to 5 days. Spawn was prepared in conical flasks, which contained boiled wheat grains (1 kg), Calcium carbonate and Calcium sulphate (1% each). Spawned compost bags were incubated for 15-20 days at 22-28 ˚C. Bags were opened at time intervals and final yield was considered for three flushes. During fruiting, the temperature at 18 to 22˚C and humidity at ~80% were maintained.

III. Results

After appropriate inoculation, spawn run was complete in 15 days in the case of dried leaves and grass, whereas it was complete in 12 days in wheat and paddy straw. Pinheads appeared within 7 days of the opening of bags in all the bags (Figures 1-6). Yields of three flushes with different substrates after 15, 18 and 20 days respectively are reported in the tables I, II and III below:

Table 1 (15 days)

Substrate	I Flush (g)*	II Flush (g)*	III Flush (g)*	Total (g)*
Paddy	50	45	25	120
Wheat	49	45	26	120
Polyalthia longifolia	55	50	35	140
Cynodon dactylon	60	50	42	152

Table II (18 days)

Substrate	I Flush (g)*	II Flush (g)*	III Flush (g)*	Total (g)*
Paddy	50	46	28	124
Wheat	48	46	29	123
Polyalthia longifolia	53	50	42	145
Cynodon dactylon	58	50	52	160

Table III (20 days)

Substrate	I Flush (g)*	II Flush (g)*	III Flush (g)*	Total (g)*
Paddy	50	45	27	122
Wheat	48	46	26	120
Polyalthia longifolia	55	48	37	140
Cynodon dactylon	60	48	47	155

* mean for 3 trials; substrate 200 g dry weight

Figs.1-6. 1- Mycelium fully grown in Ashoka tree leaves after 5 days; 2- Basidiocarps appeared in Ashoka tree leaves after 15 days, mycelium can also be seen; 3-Basidiocarps coming out from two sides from garden grass substrate; 4- 15 days old basidiocarps on wheat straw ; 5- Cluster of young basidiocarps; 6- A ventral view of fully grown mature basidiocarps of *Pleurotus sajor-caju* showing gills.

IV. Discussion

Chitamba et al (2012) found cotton lint waste as suitable substrate for production of *Pleurotus sajor-caju*. Randive (2012) cultured Oyster mushroom on wheat and paddy straw. Paddy straw was used as substrate for growing *Calocybe indica* at a temperature range 20˚- 35˚C (Josephine and Sahana, 2014). Sofi et al (2014) found wheat straw in combination with wood chips suitable for cultivation of *Pleurotus ostreatus*. Substrates like paddy straw, banana stem, sugar cane bagasse milled, sorghum husk, coir pith and sunflower stem were utilized for cultivation of *Pleurotus florida* and *Calocybe indica* by Velusamy et al (2014).

Grass (*Cynodon dactylon*) and leaves of Ashoka tree (*Polyalthia longifolia*) were found to be excellent source of lignocellulosic rich substrate for cultivation of *Pleurotus* species. They were found to produce more yield than the traditionally used straws i.e. wheat and paddy. Yield in all the flushes overcomes the traditional straws. Experiments are in progress for the Municipal solid waste compost. If a robust and convenient method for collection of dry grass and leaves is managed, this technology can be used on a semi-commercial scale to convert lignocellulosic waste into protein rich fruits.

V. Conclusions

We conclude that these two substrates *Cynodon dactylon* and *Polyalthia longifolia* have not been used earlier by others for cultivation of mushroom. Yield of *Pleurotus* on these substrates was found to be higher than commonly used wheat and paddy straws. This technology of *Pleurotus* cultivation can be used at a commercial scale by the farmers by utilizing these wastes (grass and leaves) in their surroundings.

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