

# **INTEGRATED APPROACH FOR BIOCONVERSION AND UTILIZATION OF ORGANIC WASTES**

*Thesis submitted*  
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*by*  
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*Dedicated*  
*to*  
*My father*  
*and*  
*My children*  
*Karmendra*  
*&*  
*Neva*

## CERTIFICATE

This is to certify that the thesis entitled "**INTEGRATED APPROACH FOR BIOCONVERSION AND UTILIZATION OF ORGANIC WASTES**", submitted by **Ms Shova Patrabansh** has been prepared under my supervision in conformity with the rules and regulations of Indian Institute of Technology, New Delhi, India. The research report and results presented in this thesis have not been submitted for any degree or diploma in any other University / Institute.

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A handwritten signature in black ink, reading "Patrabanish" with a horizontal line underneath.

(Shova Patrabanish)

## ABSTRACT

In the present study, three different organic wastes, namely, sericulture waste, *Populous deltoides* (Marsh) Batrer leaves and *Eupatorium adenophorum* Spreng. weeds were selected for their utilization through appropriate technologies in an integrated way. The cultivation of *Pleurotus sajor-caju* (Fr.) Singer have been done in triplicate sets on all three wastes used individually or in admixture with paddy straw. The highest yield of fruiting bodies of *P. sajor-caju* was observed in the cases of mixtures of *P. deltoides* and *E. adenophorum* with paddy straw in the ratio of 1:2 with 409.91 g per 400g of substrate. The highest biological efficiency of (102.47%) was found in both the substrates. The proximate analysis of fruiting bodies of *P.sajor-caju* in terms of crude protein, total carbohydrate contents varied from 31.65% to 33.81% and 42.8% to 47.7% respectively on different substrates. The variation in the content of crude fat, crude fibre and ash ranged from 1.57% to 2.3%, 12.70% to 18.01% and 5.64% to 7.61% respectively on different substrates. The energy value of the fruiting bodies was found to be between 282 to 309 (kcal/100g) whereas the energy recovery of the substrates in the fruiting bodies was from 2.10% to 8.73%. Among the eight elements analyzed in the fruiting bodies, potassium content was highest followed by phosphorus, magnesium, sodium, calcium, iron, manganese and zinc respectively.

Experiments on biogas production were carried out in batch type laboratory scale digesters, for digestion of all three substrates under study (alone and in mixed state). The spent residues of different substrates obtained after mushroom cultivation were also used for biogas production. Maximum gas evolution was recorded in the

case of *P. deltooides* spent residues ( $519 \pm 8$  litres/kg of total solids). The percentage of methane was highest (72%) in the gas obtained from digesters with spent *P. deltooides*. The nitrogen content in digested organic wastes was observed to be higher than that in undigested substrate. There was significant reduction in the cellulose (22.79% to 51.91%) and hemicellulose (22.00% to 51.56%) content after degradation whereas there was practically no reduction in lignin content. The reduction in total solid content and volatile solid content was higher in the digesters with spent residues (substrates after cultivation of mushrooms) than in untreated organic wastes.

Extraction of dyes from all three wastes under study was attempted by boiling the material in water. The extract was used for dyeing wool and silk fibres. Darker shade was observed when the fibre was dyed with the extract from *E. adenophorum*. A range of colours was obtained with different mordants.

Both sericulture waste and *P. deltooides* leaves were found to be good substrates for the production of cocoons of *E. foetida* ( $239 \pm 14$  and  $222 \pm 8.3$  respectively). However, for hatching and earthworm biomass production, sericulture waste (320% and 252.29% respectively) was best followed by *P. deltooides* and *E. adenophorum*. *E. foetida* was used as an indicator of response to different hormone treatments : Naphthaleneacetic acid (NAA), Giberellic acid (GA), and Indole-3-acetic-acid (IAA). Among these, NAA gave maximum increase in earthworm biomass. The vermicompost was applied to radish and spinach vegetable crops to evaluate its fertilizer value. Its nutritive value was found to be comparable to that of chemical fertilizers. After harvesting the two vegetable crops, the physico-chemical analysis of the soil samples was carried out. It was observed that there was slight improvement in the fertility value of soil.

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