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Utilization of Biogas Digester Liquid for Higher Mushroom Yeilds

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Abstract

Biomass based biogas plants play important role in the sustainable development of rural India. These biogas plants apart from providing biogas (CH_4+CO_2) that can be used for cooking and other purposes also provide two other byproducts such as Biogas Digester Liquid (BDL) and Biogas Digester Residue (BDR).These byproducts contain proportion of locked nitrogen in the form of ammonia, and other nutrients such as phosphorus that can be further utilized to produce valve added products like mushroom .In this study biogas digester liquid was used as a nutrient supplement in place of water for cultivation of mushroom specie like P.florida .it was observed that the mushroom bags supplemented with biogas digester liquid gave higher yield (P.florida gave 2.4kg/kg substrate) compared to bags sprayed with water (standard bags,1.5kg/kg substrate). The time required for pin head formation, fruiting body was also reduced by spraying biogas digester liquid. Also the mushroom samples, leachate and solid substrate were analyzed for TKN, TP and TOC. Higher degradation of the substrate was seen in P. florida by spraying BDL than compared to control bags that were sprayed with water.

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Keywords: Biomass, Biogas Digester Liquid (BDL), P. florida, Higher yields, Carbon balance for mushroom growth, Nitrogen and phosphorus balance;

1. Introduction

India being an agricultural country generates 1200Mt/year of agro-residues which can be utilized for energy production (Chanakya and Malayil 2012 a & b). Anaerobic digestion of these agro-residues and their sub components leads to conversion of cell-wall protein, hemicelluloses and part of cellulose to biogas by anaerobic microbes. The undigested slurry contains certain amount of cellulose and lignin which cannot be utilized by the

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most of the anaerobic microbes and requires specific enzymes which are seen in Basidiomycetes (Hasegawa et al.2012 ,raposo et al.2011,gunasheelan 2004).

Anaerobic digestion of agro-residues in a plug flow type biogas plant designed at IISC gives three main types of output 1)Biogas 2)Biogas Digester Residue (BDR) 3)Biogas Digester Liquid (BDL) (Chanakya and Malayil 2012 a ,b & c, Chanakya et al.2009). BDL and BDR are rich in nutrients like nitrogen in the form of ammonia, phosphorus, carbon and other essential minerals. Such nutrient rich BDR and BDL has been tested for various purposes like fertilizer (Abubaker 2012) and mosquito repellent with low efficiency whereas studies have shown that application of these to soil directly lads to leaching and loss of nutrients. Basidiomycetes are the only organisms which are found to efficiently utilize these nutrients (Ragunathan and Swaminathan).

Spent biomass from biogas plants are rich in nutrients and retains about 40% to 60% of the cellulose and lignin (Ganguly and chanakya 1994) thus providing adequate nitrogen rich substrates for the cultivation of edible mushrooms and generates cash outflow by the use of biogas plants in the rural areas. This paper focus on cultivation of mushroom species *P.florida* supplemented with BDL and the samples was analyzed for their yield and efficiency of nutrient uptake.

2. Materials and Methods

2.1 Materials

Ready to fruit mushroom bags were procured from IIHR, Bangalore. These prepacked bags contain1kg of the paddy straw mixed with 5-10% of the spawn and spawn running is carried for 25 days. Biogas digester liquid is collected from the biomass biogas plant (plug flow type reactor) installed at IISC .This BDL is filtered (50 micron mesh) and sterilized by autoclaving and stored in the can for later use.

2.2 Physio-Chemical Analysis

Moisture content was determined by determined by drying the samples in oven at 100°C for 24 hrs. Total organic carbon (TOC) for solid substance was determined by dry oxidation method using muffle furnace at 550°C. TOC for leachate was determined by micro-dichromate oxidation method (maciolek 1962). Total kjeldahl nitrogen (TKN) free ammonia for both solid and liquid samples was determined by kjeldhal method (APHA 1978). Total phosphates (TP) were estimated by phosphomolydate method (APHA 1978).

3. Results and Discussion

3.1 Mushroom yeild

After 25 days of spawning period a measured amount (100 ml) of BDL was sprayed on daily basis to ready to fruit *P. florida* bags. The leachate collected everyday was stored at -4°C for further analysis. In this experiment 3 bags were used as standard bags that were sprayed with water, other 3 bags were sprayed with BDL. Time period for initiation of the pin head formation, fruiting body formation and first flush were recorded. In case of *P.florida* it was observed that spraying of BDL could reduce the time taken for various stages of mushroom growth such as pin head formation, fruiting body formation and first flush. The total yield obtained after 40 days for control bags was 1.5kgmushroom/kgsubstrate were as in experimental bags the yield was 2.4kg mushroom/kg substrate (Figure 1). The time taken for formation of pin head in control was 47d where as for BDL sprayed bags it reduced to 42d (Figure 1). Fruiting body formation was observed by 49d in control whereas it reduced to 43d in BDL sprayed bags. The first flush was harvested on 54d in control and by 46d in BDL sprayed bags. The overall cropping cycle in the current experiment was 65d.

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