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Popular Article

Circular Economy Through Use of Spent Mushroom Substrate for Vermi Compost Production

Dr. Rajkumari Padamini
Assistant Professor (Plant Protection), Multi Technology Testing Centre and Vocational Training Centre, College of Community Science- Tura 794005
Central Agricultural University Imphal
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Safety food and healthy food gain widespread popularity nowadays. Demand for mushrooms as a protein source is steadily increasing. The effect to mushrooms consumption is increasing because of mushroom are a healthy food. Mushrooms are cultivated on substrates based on plant biomass, e.g. crop residues, which are continuously increasing because of the expansion of agricultural production driven by global population growth. Therefore, besides leading to the generation of food, mushroom cultivation is an example of holistic exploitation of residual lignocellulosic biomass through an efficient continuous-flow process carried out indoors, requiring remarkably lower land areas than most other crops. Furthermore, unlike conventional agriculture, which is season-dependent, mushroom production can be performed throughout the year independently of climatic conditions and an exhausted residual substrate is generated. The substrate after growing mushrooms is usually a problem for their producers, who are most willing to get rid of the compost after harvest. The spent mushroom substrate (SMS) is a by-product generated from mushroom production, which contains a large amount of fungal mycelium and extra-cellular lignocellulosic enzymes along with various organic substances (carbohydrates, proteins, and fats), as well as a considerable quantity of inorganic nutrients such as ammonium nitrate, superphosphate, and potassium salts. Depending on the nature of the materials used for formulating the substrate, the type of production system, and the cultivated species, three to five kg of SMS is generated per kg of fresh mushrooms. In total, 64 million tons of SMS were generated worldwide by the mushroom industry in 2018, and this figure could escalate to above 100 million tons by 2026. Cultivation remnants and the substrate itself attracts flies and other insects that can transmit diseases and are a potential source of water and air pollution. Some of the current disposal strategy of SMS/SMC in the world is by burning, spreading on land, burying, composting with animal manure, or very much common

by landfilling. Currently, disposal by burning is one of the chief methods for coping with the accumulation of plant residues. However, this widespread practice is against sustainability principles, contributes substantially to air pollution, and results in a considerable waste of biomass resources that are highly valuable for generating materials, fuels, and chemicals of high economic and social value. Environmental regulations have forced mushroom farmers to look for more environmentally friendly ways of utilizing residual substrate. On the other hand, there is demand for organic fertilizers and compost increased due to increasing restrictions on the use of synthetic pesticides and mineral fertilizers in agricultural and horticultural cultivation. The valorization of crop residues for production of vermi compost is crucial for the sustainability of agricultural production. Valorization of SMS is crucial for developing a sustainable mushroom industry in the frame of a circular-economy model. Circular economy implies that agriculture implies that agricultural waste will be the source for retrieving high value-added compounds.

The major components of mushroom waste substrate are sawdust, wheat straw, paddy straw, etc. which are degraded during the process of mushroom production. Mushroom waste substrate can be converted into valuable material by composting. This process is simple, economically valuable and safe for human health and environment as a waste management technology. Composting can be performed utilizing e.g. earthworms – this is known as vermicomposting. It is a biological method that relies on earthworms farming to convert organic matter into high quality organic fertilizer. Earthworms break down and degrade the waste by ingesting the organic materials, i.e. plant litter, soil organic matter and mineral soil particles. Contents of plant nutrients, hormones, beneficial enzymes and microbes in vermicompost is higher in contrast to conventional compost. However, the process of vermicomposting is very dependent on the type of substrate and species of earthworm used. Waste from mushroom cultivation could improve vermicompost quality. It was found that the spent mushroom substrate contained high protein and carbon content as a food source for earthworms. It can increase the amount of nutrients and microorganisms that are beneficial to plants. In general, recycling of spent mushroom substrate through vermicomposting may reduce the environmental stress and can produce organic fertilizers with better chemical and biological properties.

Through such interventions the farmers' empowerment for self-employment by adopting the technology transfer on cultivation of mushroom and preparation of vermicompost. Adopting such technologies will help in developing the entrepreneurship skills through hands on training cum method demonstration to be imparted. These will also up-liftment the social and economic status of the farmers through income generation from the enterprises.

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