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Potential, Economics and Constraints of Mushroom Cultivation in Wayanad, Kerala

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ABSTRACT

Mushroom production has enormous potential to improve food security and financial security, resulting in higher economic growth. The study was conducted in the farmer's setting and laboratory of Krishi Vigyan Kendra, Wayanad. The data for economic analysis and farmers' constraints was the response data collated from Wayanad farmers who attended the training programmes on mushroom cultivation at KVK Wayanad. Experiments on mushrooms were conducted as FLDs and OFTs of KVK in the KVK laboratory and farmer's setting. Experimental trials prove that the respondents prefer *Pleurotus cystidiosus* due to its higher yield, B: C ratio, and fewer days for bud initiation. The comparative economic analysis of the various agricultural enterprises revealed that value addition in mushrooms is highly profitable. The study also shows that milky mushroom production is not beneficial in the study area and banana pseudostem waste is a suitable substrate for mushroom cultivation. Results also unveil that unorganized market structure is the major constraint faced by the farmers.

Key Words: Constraints, Cultivation, Economics, Mushroom, Potential.

INTRODUCTION

Wayanad district in Kerala is an agricultural area where most of the population depends on a subsistence wet-paddy integrated agro-ecosystem, which has given way for more lucrative cash crops like banana and ginger (Nagabhatla and Kumar, 2013; Padmanabhan, 2011). At the same time, climate variability and change had induced severe threats to the people of Wayanad's livelihood with landslides and floods, along with concurrent droughts (Radhakrishnan and Gupta, 2016) that leads to considerable crop loss. Hence, farmers cannot remain solely dependent on agriculture for their livelihood, and if the crop fails, there should be a source of subsidiary income for farmers. Such a remunerative option is mushroom cultivation that doesn't involve the capital land, and it can be quickly done by any farmer in rural or urban settings. Mushrooms are very nutritious products that can be generated from lignocellulose waste materials and are rich in crude fiber and protein. It is a meat substitute, and its nutritional value is comparable to many vegetables (Thakur, 2020). *Agaricus bisporus, Lentinula edodes,* and *Pleurotus spp* rule the commercial market, representing three-quarters of mushrooms cultivated globally.

Among the cultivated mushrooms, Oyster mushroom (*Pleurotus spp.*) belongs to the family of Tricholomataceae. It is the second commonly cultivated mushroom globally, next to *Agaricus bisporus* (Sanchez, 2010). Though researchers and extension agents highly recommend it, the farmers find various constraints in adopting mushroom enterprise in Wayanad analyzed in the present study. In Wayanad, around 17 percentage of the total population are tribes, roughly one-third of all the tribes of the State (Anonymous, 2011). These communities form the poorest section of the people, and they fall behind the rest of the population of Kerala in terms of literacy, income, nutritional status, and health (Narain,2019). Thus, there is a vast scope to incorporate mushrooms in the dietary

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pattern of the Wayanad population, especially the tribes, to improve nutritional security. It should be kept in mind that efforts to increase the production without solving its marketing problems, would not be useful.

Contrary to the enormous potential, the actual production of mushrooms in Kerala is miserably small. Exertions of increasing output without solving the production constraints will be counterproductive. Thus, the study was conceptualized to assess the oyster mushroom varieties suitable for Wayanad, cost-benefit analysis of mushroom production, value addition, and evaluate socioeconomic constraints faced by farmers in adopting technology.

MATERIALS AND METHODS

Assessment of oyster mushroom species suitable for Wayanad

During 2017-18, an on-farm -testing was conducted to evaluate different species of *Pleurotus* in Wayanad; six trials were undertaken in various farmers' fields.

Mushroom spawn production

The laboratory experiments were carried out in mushroom spawn production laboratory, KVK Wayanad. Three species of oyster *mushroom Pleurotus florida, Pleurotus eous and Pleurotus cystidiosus* were obtained from the Department of Plant Pathology , College of Agriculture , Vellayani Kerala Agricultural University. These were grown on potato dextrose agar medium (PDA) at 28℃ for regular subculture and maintained on PDA at 4℃ for a maximum of 3 months. Spawns were prepared in 850 ml glass bottles filled with 1% calcium carbonate. Jower/Sorgum seed was used as a substrate for producing oyster mushroom spawn. Seeds should be soaked for about twelve hours. Sterilize the seeds inside those containers by heat and vapor pressure sterilization using a pressure cooker. In general, 30 minutes at 15 psi is recommended for the sterilization. After cooling to room temperature, 10 mycelium discs (diameter 1 cm) of each oyster mushroom were inoculated into each bottle of sterilized spawn. The spawn was incubated at 28℃ until the substrate was fully colonized. Seeds should be soaked for about twelve hours. Substrate preparation and multiplication using mother spawn is done following standard methodology (Chang and Miles, 1989).

Paddy straw substrate preparation

Clean, dry contamination-free straw collected right after harvest was used for substrate preparation. The straw was wholly dried under the sun, chopped into pieces of 4 cm length, and soaked in water overnight. After draining the excess water, straw was soaked in hot water at 70˚C - 80˚C for 45 minutes, drained, and used to prepare beds.

Spawning of substrate

The spawning should be done in a pre-fumigated room (48 h with 2% formaldehyde). The spawn should be mixed @ 10% of the dry weight, and Spawned substrates can be filled in polypropylene bags (30 x 60 cm) of 150-200 gauze thickness. 10-15 small holes (0.5-1.0 cm dia) should be made on all sides, especially two to four holes in the bottom for draining excess water.7-8 holes of 0.5 -1 cm diameter made all over the bag for aeration. The perforated polythene bag was filled for about 5 cm height with the sterilized straw and pressed with hand to make it even.

Substrate preparation using banana pseudostem

Banana pseudostems were collected and split into two halves longitudinally and sundried. These were later cut into small pieces of around 30 cm in length. These were made into bundles and beds prepared as that made from paddy straw.

Socioeconomic constraints faced by farmers in the adoption of technology.

Primary data

Primary data were collected from farmers who attended the various mushroom production training conducted by KVK Wayanad. The participants of

Table 1. Assessment of oyster mushroom species in Wayanad district.

Technology option	Days to bud initiation	Yield/bed	Consumer preference	BC ratio
Control (*Pleurotus florida*)	12th day	1.26 kg	Yes	1.15
Pleurotus eous	15th day	1.03 kg	No	0.94
Pleurotus cystidiosus	6th day	2.16 kg	Yes	1.41

six batches of mushroom production and processing training from different blocks of Wayanad are the respondents. The data were collected using focus group discussions, training feedback, semi-structured interviews, and telephonic interviews from 120 mushroom trainees for the study from 2017 to 2020.

RESULTS AND DISCUSSION

The data (Table 1) revealed that among the three oyster mushroom species, *Pleurotus cystidiosus* showed a higher yield than the other two. Days for bud initiation were less than the other two species, and the consumer preference was high for *Pleurotus cystidiosus*. Several factors influence the productivity parameters of mushrooms (Bellettini, 2019). Field trials revealed that farmers were satisfied with *Pleurotus cystidiosus* due to more yield and less duration for bud initiation. Pleurotus cystidiosus (PC) is also a potent antioxidant. Thus, Pleurotus cystidiosus was taken for technology upscaling and distribution to farmers by the KVK Wayanad.

The values (Table 2) depict that when the different enterprises such as vegetable , banana and mushroom cultivation and value addition of mushrooms were compared, it was found that the highest net returns were obtained with value addition of mushroom followed by banana and mushroom cultivation. Hence, the benefit cost ratio was found to be the highest with value added mushroom (5.21) followed by banana cultivation (2.32). Instead of mushroom cultivation alone, its value addition and marketing will result in better profit realization. Value addition and processing are important for profit oriented mushroom cultivation. Value added products such as mushroom soup powder, pickle, nuggets, mushroom preserve and chips are popular among new generation foods (Huchchannanavar *et al,* 2020). Mushrooms have high moisture content and also delicate texture. Therefore, these cannot be stored for more than 24 hr under tropical conditions. On prolonged storage there will be weight loss, veil opening, browning, liquefaction and microbial spoilage. Hence, suitable processing techniques will reduce the post-harvest losses (Singh *et al,* 2011).

As oyster mushroom was found to be highly economically feasible, there is a need to find out whether the production of milky mushroom is possible in Wayanad conditions as it is one among the most popular cultivated mushroom varieties around the world. It was revealed that oyster

Table 2. Cost-benefit analysis of mushroom production and value addition.

Enterprise	Gross Cost (Rs./ha)	Average productivity (q/ha)	Average sale price (Rs/q)	Gross return (Rs./q)	Net return (Rs.)	B:C Ratio
Vegetable cultivation (Okra)	52,000	170	856	1,45,600	93,600	1.80
Horticulture (Banana)	165480	128	3000	3,84,000	237170	2.32
Oyster Mushroom	273	3.9 kg/bag	Rs 300/kg	545	273	2.00
Value added mushroom	345	3.9 kg/bag	Rs 1000/kg	1,800/bag	1,527	5.21

Table 3. Comparative analysis of the substrates for mushroom production.

Parameter	Yield (kg/bed)	Net returns (Rs.)	Gross cost (Rs.)	Gross returns (Rs.)	BC ratio
Paddy straw	3.9	1090	1090	2180	2.00
Banana pseudostem waste	4.5	1876	1340	3216	2.4

mushroom showed higher yield and was suitable for the Wayanad climatic condition whereas, milky mushroom not suitable under this condition. After the spread of mycelium, the bud initiation was low or zero. The suitable temperature range for milky mushroom yield is 25-35^{0}C, with a combination of 80-85% relative humidity throughout the year (Navathe *et al,* 2014). The weather conditions of Wayanad were not suitable for the production and the experiments show that the milky mushroom production failed. Thus, the farmers prefer to cultivate Oyster mushroom.

The data (Table 3) show that by demonstrating oyster mushroom production using banana pseudostem waste as substrate farmers were able to generate more income from underutilized pseudo stems. Yield obtained with pseudo stem waste substrate was on par with paddy straw and other substrates. Difficulty was that the storage life of the substrate was less and the process of drying pseudostem waste is cumbersome. Farmers were satisfied since yield was good and acceptability of mushrooms was also high.

As implied in Table 4, mushroom production has various constraints, as indicated by the mushroom trainees of KVK Wayanad. Among that, the sale of produce due to the unorganized market structure was the major one. Researchers have revealed that non-availability of spawn, lack of well-organized markets, insufficient knowledge about financial assistance, news on mushroom poisoning, and inadequate knowledge about mushroom preservation and recipes of mushroom items are the significant constraints towards sustainable mushroom production (Majumder *et al*, 2009 and Sharma *et al*, 2016). Value addition and various types of processing could be the ways to tackle the marketing issue as a continuous market is challenging (Wakchaure, 2011). Studies reported unavailability of quality spawn was the highest-ranked technical constraint (Roy *et al*, 2020), followed by high pest incidence and diseases. The availability of quality mushroom spawn is not a significant issue as it is available throughout the year from KVK Wayanad, situated at Ambalavayal village. Still, pests and diseases cause substantial losses in Wayanad also.

Table 4. Ranking of socio-economic constraints. **(n=120)**

Sr. No	Socio economic constraint	Respondents (%)	Rank
1	The sale of produce is quite tricky because of the unorganized marketing infrastructure	90	1
2	High microbial contamination and poor return due to improper post-harvest handling, storage, packaging, transportation, and no value addition, pests, and diseases.	85	2
3	Lack of infrastructure	50	3
4	Lack of technical and financial support for production and management practices	25	4
5	Erratic local demand for mushroom	20	5
6	Perishable nature of commodity results in losses	15	6
7	Non-availability of substrates and other basic raw materials as and when needed	10	7

High microbial contamination and poor return due to improper post-harvest handling, storage, packaging, transportation, and no value addition, pests, and diseases are the other significant constraints (Roy *et al*, 2020), as reported by Wayanad farmers also. Mushroom production also faces high competition with other protein non-vegetarian diets like chicken, egg, and fish. Vocational training programmes provided technical knowledge to the rural. They effectively brought qualitative gain in understanding the beneficiaries (Bathla et al, 2018) that must be enhanced to tackle Wayanad farmers' constraints. Findings on mushroom training reveal that after imparting technical knowledge and skill to the participants to the maximum possible extent, the trainees or the farmers were putting less effort into implementing scientific practices (Sharma and Singh, 2018) that may be due to the ineffectiveness of training.

CONCLUSION

Mushroom cultivation could provide additional income and employment along with valuable dietary addition. A large number of factors affect the production of mushrooms in Wayanad. Market linkage and survey are essential to know the demand and broader utilization of mushrooms in Wayanad and laboratory assessments to determine the suitability. Mushrooms are a highly perishable commodity. So, the value addition of cultivated mushrooms is very much essential for economic feasibility and also for long time storage of food. There is a vast awareness gap in understanding the cultivation practices, dietary importance, and medicinal properties of mushrooms that need to be bridged through the extension system.

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