

Original Research Article

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Cultivation of Button Mushroom (*Agaricus bisporus*) Under Controlled Condition: An Initiative in Bastar Plateau of Chhattisgarh

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ABSTRACT

The experiment was conducted at Mushroom Production unit at SG College of agriculture and research station, Jagdalpur during July 2017-January 2018 under controlled condition. Fresh culture of *Agaricus bisporus* S-11 was maintained on potato dextrose agar. Compost was prepared by short method of composting and cultivation trials of *Agaricus bisporus* S-11 was carried out in a closed room provided with air conditioner as source of cooling. The relative humidity inside the cropping rooms was maintained to 60-70%. Spawn run completed in 15 days and required 12-15 days more for case run. The pinheads developed into solid button sized mushrooms in another 5-7 days. Morphological characteristics recorded for this mushroom revealed an average stipe length of 3.02 cm having girth of 1.7 cm. While the average pileus length and width was 2.1 cm and 3.37 cm respectively. Mushroom yield of 18.17 kg/100 Kg compost was recorded. Average weight of mushroom recorded was 19.1 kg with average number of fruiting bodies of 960 from 100 kg of compost. Benefit cost ratio for mushroom cultivation was estimated to be 1.98.

Keywords

Spawn, Pinning, Casing, Composting

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Introduction

Agriculture has remain be the major force of Indian economy but a fight is still on to meet the ever increasing demand of nutritional security following secondary agricultural vocation. To meet such challenges, diversification in the agricultural activities which include mushroom production is important to address the problems of quality food, health and environmental sustainability (Singh *et al.*, 2017). In the present diet conscious era, mushrooms are increasingly considered as a future vegetable and their

consumer demand has markedly expanded in the recent years owing to its medicinal and nutritional properties. Mushrooms are considered as a potential substitute of muscle protein on account of their high digestibility (Pavel, 2009). In addition to protein, mushroom is an excellent source of vitamin-D, minerals such as potassium, iron, copper, zinc and manganese, low in calories, fat free, cholesterol free, gluten free and very low in sodium (Sharma *et al.*, 2017). From 2010-2017, the mushroom industry in India has registered an average growth rate of 4.3% per annum. Out of the total mushroom produced,

white button mushroom share is 73% followed by oyster mushroom (16%), paddy straw mushroom (7%) and milky mushroom (3%) (Sharma *et al.*, 2017).

The white button mushroom (*Agaricus bisporus*) is very popular throughout the world and is the most important mushroom of commercial significance in India (Maheswari 2013). It belongs to phylum Basidiomycota, class Agaricomycetes, order Agaricales and family Agaricaceae. Initially, white button mushroom production was confined to temperate hilly regions of India. However, with the development of short method of composting and optimization of fruiting conditions using the chilling system, there has been a remarkable change in its production scenario and spread to all the corners of the country. Considering this, experiment was designed to cultivate button mushroom under laboratory condition as climate of Bastar plateau of Chhattisgarh does not permit for natural button mushroom production.

Materials and Methods

Organism and culture conditions

Fresh pure culture of *Agaricus bisporus* S-11 was procured from Indira Gandhi Agricultural University (IGKV), Raipur. The culture was grown on Potato Dextrose Agar (PDA) medium. The culture was stored at 4°C and sub cultured periodically at an interval of three weeks.

Spawn production

Wheat grains were used as support media for spawn production. Wheat grains were boiled in water for 30 min (wheat grains: water, 1:2 w/v) so as to cook them soft enough to be pressed within the fingers. Extra water was sieved out, the grains were allowed to cool and then mixed with calcium carbonate and

calcium sulphate powder @ 10g/kg of wheat grains respectively. Empty glucose bottles were filled with these grains @ 250 g per bottle, plugged with non-absorbent cotton, wrapped with paper and then autoclaved at 15 psi for 30 min. After cooling the autoclaved bottles overnight, these were shaken to restore transparent visibility of the glass and then inoculated aseptically with mycelial bits from the slant cultures. The bits were placed in such a manner that their mycelium touched the grains. These bottles were incubated at 22±1°C for 15-20 days. The culture bottles thus produced were the Master/mother cultures. After 10 days, Master/mother culture was shaken so that grains were transferred into 10-15 freshly prepared bottles. These spawn bottles were stored at 25^o C to use for spawning the substrate.

White button mushroom cultivation method

Composting

Fresh, good quality wheat straw was spread on pucca floor and wetted thoroughly for 48 hours while keeping it in the form of loose heap (=0.5m high) to attain 70-75% moisture content. Considering stacking day as 0 day, first turning was done 3 days after stacking, urea @ 1.8 kg/ qt of straw was mixed with wet straw, again stacked into heap and covered with polythene and kept overnight to facilitate solubilization of the chemical fertilizer and their adsorption on to the bran.

Subsequent turning was done at 3 days interval with a total of seven turns required for complete decomposition of compost. Wheat bran (choker) @ 2.5 kg per quintal of straw was mixed during 3rd turning, while gypsum was mixed during 6th turning @ 3.5kg/ qt of straw. Light brown colored compost having no smell of ammonia was allowed to cool down before spawning (Garcha and Kiran, 1981).

Filling and spawning

Good quality compost was mixed with *A. bisporus* spawn (@ 0.7-1.0% of wet compost weight) and filled into polythene bags of size 18×20". The spawned compost was then compressed, leveled and mouth of polythene bags was covered with a clean newspaper. Compost filled bags were then shifted to the growing room until complete mycelia impregnation. Holes were made throughout the bag to allow aeration. The filled bags were incubated at 21 C - 23 °C with sufficient light and humidity and water was sprayed on top of the bags covered with newspaper, twice a day throughout spawn running period.

Casing

Casing mixture was prepared by mixing coco-peat, soil and sand (3:2:1 v/v). Coco-peat instead of farmyard manure was used because of easy availability in Bastar plateau. Moreover, because of its unique water holding and structural properties, coco-peat has been regarded as the most suitable and more ideal for casing (Kaur and Rampal, 2017). All the ingredients were separately sterilized for 30 minute at 121°C at 15 psi before mixing. The sterilized casing mixture was used to cover spawn impregnated compost bags at uniform thickness of 3-4 cm following removal of newspaper. Case run was considered complete when mycelia covered the top of casing layer. Case run was done at a temperature of 21 - 23 °C. Spraying of water was continued directly on cased bags till the end of cropping.

Crop management and harvesting

An air conditioner room of 10X 12 sq. feet was used for cultivation. Very little or no ventilation was provided until the appearance of first pin heads. Thereafter intermittent cross-ventilation was given for period of total 3-4 hrs per day. A temperature of 21-23°C

was maintained during spawn run period and 15-20°C after pin head stage. Relative humidity of 70-80 percent was maintained throughout the cultivation. Mushrooms were harvested by gentle twisting and the soil end parts of fruit bodies were cut off. The yield data was recorded daily for number of fruit bodies and their weight was observed. Spray of water was also continued on cased bags till end of crop. Yield data for total number and total weight of fruiting bodies per bag was recorded up to a period of 4 weeks following appearance of pin head and biological efficiency was calculated as

$$\text{Biological efficiency} = \frac{\text{Total weight of fresh mushroom}}{\text{Total dry weight of compost}} \times 100$$

Estimation of gross income, net profit and benefit cost ratio

Gross income was calculated by multiplying the total production of mushroom by the selling price (Rs 200/Kg of mushroom). Net profit was calculated by subtracting total production cost from gross income. Benefit cost ratio was calculated by dividing total income by total expenditure.

Results and Discussion

The experiment was conducted at Mushroom Production unit at SG College of agriculture and research station, Jagdalpur during July 2017-January 2018 under laboratory condition. Fresh culture of *Agaricus bisporus* S-11 was maintained on potato dextrose agar.

The fungal strain exhibited full mycelial growth (9 cm) in 22-25 days at 22 ° C. In their study Yadav and Chandra (2014) reported that mycelial growth of three strains of *Agaricus bisporus* S-79, A-15 and Delta on PDA were obtained fast and full growth (9 cm) completed in 8, 10 and 12 days respectively.

The data for cultivation of button mushroom has been depicted in table 1 which comprised growth behavior, morphological characteristics and yield attributes. The results indicated that the spawn run completed in 15 days and required 12-15 days more for case run. During this period no ventilation was provided as there is no requirement for fresh air introduction during case run. After case run, the environmental conditions was changed by bringing down the temperature to 16-18°C provided by air conditioner and providing proper ventilation for exhausting excess CO₂. This change in environmental parameters induced pinhead formation in 2-3 days time. The pinheads developed into solid button sized mushrooms in another 5-7 days.

At this stage, the air inside the cropping room was changed 4-6 times to maintain appropriate CO₂ concentration as CO₂ production is at its peak during first flush. The subsequent harvesting was made at an interval of 4-5 days and data was recorded for 4 weeks. In a report

evaluating different strains of *Agaricus bisporus*, Kumar *et al.*, (2017) reported that number of days taken for spawn run ranged from 14-17, minimum being in NCS-465 (14 days) and maximum in NCS-459 and A-15 (17days), while time required for case run ranged for 13-18 days and pinhead formation from 15-21 days.

Morphological characteristics recorded for this mushroom revealed an average stipe length of 3.02 cm having girth of 1.7 cm. While the average pileus length and width was 2.1 cm and 3.37 cm respectively. Kumar *et al.*, (2017) reported average length of stalk in the range of 1.6-3.5 cm, maximum was observed in Portbella (3.5 cm) followed by A-15 (3.2 cm), U-3 (2.8 cm), Delta (2.4 cm), NCS-459 (2.2 cm), and minimum average length of stalk was NCS-465 (1.6 cm), whereas width of stalk ranged from 1.2-2.5, maximum again being with Portbella (2.5 cm). They further reported average length of mushroom cap in range of 3.0-5.0 and width 3.0-4.8 cm.

Table.1 Cultivation of *Agaricus bisporus* under laboratory condition

Growth behavior	
Spawn run (d)	15
Case run (d)	12-15
Pin head emergence (d)	2-3
First harvest (d)	5-7
Last harvest (d)	30
Yield performance	
Yield (kg/100kg)	18.17
Number of fruit bodies (/100kg)	979
Average weight of fruit bodies (g)	19.1
Biological efficiency (%)	18.17
Morphological characteristics	
Average stipe length (cm)	3.02
Average stipe girth (cm)	1.7
Average pileus length (cm)	2.1
Average pileus width (cm)	3.37

Table.2 Economics of mushroom cultivation under laboratory condition (Production cost per 500 Kg of compost)

Expenditure	Rupees
Wheat straw @ Rs 1200/100kg	6000
Labour	4500
Electricity charges	1500
Spawn, polythene bags	1500
Miscellaneous (Urea, gypsum, wheat bran etc.)	500
Total expenditure	12500
Income (124.42 Kg mushroom @ Rs 200/kg)	24804
Net income	12384
Benefit cost ratio	1.98

Enlightening the yield performance, mushroom yield of 18.17 Kg/100 Kg compost was recorded. Average weight of mushroom recorded was 19.1 kg with average number of fruiting bodies of 979 from 100 kg of compost. Diamatopoulou and Philippoussis (2001) observed maximum yield (30.84 kg of edible mushroom biomass) in white strain 207 among five *Agaricus bisporus* strains. Singh *et al.*, (2017) recorded 18.27 kg/100 kg compost yield from AVT-02 followed by 14.30 Kg/100kg compost from AVT-06 button mushroom strains. Kumar *et al.*, (2017) reported average individual fruit body weight of 12.00 gm while Singh *et al.*, (2017) recorded maximum average weight of fruit body of 14.79 in AVT-01.

Environment controlled mushroom production unit of size 10 X 12 sq. feet was used in the present experiment. Table 2 presenting the economics of mushroom cultivation (per 500 Kg of compost) under controlled condition revealed a total income of Rs 24,804 against total expenditure of Rs 12,500 with benefit cost ratio of 1.98. Use of family labour for different operations may further reduce the expenditure making the farmer self-confident in raising the crop with great remuneration. While investigating economics of button mushroom production in selected areas of Bangladesh, Barmon *et al.*,

(2012) found mushroom to be a profitable agricultural enterprise with a benefit cost ratio (BCR) of 1.55.

The present results indicate that button mushroom can possibly be cultivated under laboratory condition. This can be a means of livelihood and a source of economic empowerment for women in both urban and rural areas, and for small holder farmers, apart from being a source of food production.

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