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Effect of Casing Mixtures along with Turmeric Powder on the Growth Parameters and Yield of White Button Mushroom [*Agaricus bisporus* (Lange) Imbach]

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Protein is one of the nutrients that is included in balance diet for proper growth and development of humankind. The amount of food that is needed for human consumption is insufficient. Agaricus bisporus (Lange) Imbach commonly known as white button mushroom, is the most widely accepted food globally with nutritional and medicinal properties. The present experiment was conducted during the *Rabi* season 2023 at Mushroom crop room, Department of Plant Pathology, SHUATS, Prayagraj, Uttar Pradesh to evaluate the effect of Turmeric powder at different concentrations (0.5%, 1%, 1.5%, 2% and 2.5%) incorporated into three different casing mixture *viz.,* FYM +

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Cocopeat + Sawdust (1:1:1) with an objective to monitor the growth and yield aspects of white button mushroom. Turmeric at concentration 2% shows significant increase of weight of fruiting bodies, enhances stalk length, stalk diameter and pileus diameter. These results were also observed at 2.5% concentration but it also inhibited the growth of mold fungus as well as *A. bisporus.* Among all treatments used in the study, the results revealed that minimum average time taken for completion of spawn run (15.28 days) and pinhead initiation (17.29 days) as well as maximum pileus diameter (4.87 cm), stalk length (3.32 cm), stalk diameter (2.36 cm), yield (583.33 g) and biological efficiency (13.56) highest recorded in T4 [FYM + Cocopeat + Sawdust (1:1:1) + Turmeric powder @ 2%.

Keywords: Agaricus bisporus; casing; cocopeat; FYM; sawdust; turmeric powder; white button mushroom.

1. INTRODUCTION

Mushrooms is a fruiting body of a separate group of organisms called fungi. They are achlorophyllous and grow on dead and decaying organic materials. From these decaying substrates, they absorb their nutrition with the help of very fine threadlike structures (mycelium) which penetrate into the substratum and are generally not visible on the surface. After the mycelium has grown profusely and absorbed sufficient food materials, it forms the reproductive structure which generally comes out of the substrate and forms fruiting body, commonly known as Mushroom. The mushroom fruiting body may be umbrella like or of various other shapes, size and colour (Kumar et al., 2022). It belongs to phylum: Basidiomycota, class: Agaricomycetes, order: Agaricales and family: *Agaricaceae* (Netam et al., 2018).

Mushrooms have likely been a part of human diet since ancient times, and today they are even more important for our nutrition. The cultivation and production of edible mushrooms are growing, especially in Europe, America, and Asia. This rise in popularity is due to the high nutritional value of quality mushrooms, which is nearly equivalent to that of milk (Sharma et al., 2017). Mushrooms are highly beneficial for a vegetarian diet because they provide essential amino acids that are usually found in animal proteins. They help boost the immune system, inhibit tumor growth, and reduce cancer risk. Additionally, mushrooms assist in balancing blood sugar levels, fight off viruses, bacteria, and fungi, reduce inflammation, and support the body's detoxification processes (Sharma, 2020).

Mushroom production in the world has increased more than five times since 2000 and presently, it stands at as 44 million tonnes (FAOSTAT, 2023). India stands at number six with around 0.24 million tonnes production (FAO, 2023). In India, during the period between 2021-2022, Bihar (11%) with 28000 tonnes tops the list followed by Maharashtra (10%), Orissa (9.66%) in the top mushroom producing states in India [Agricultural and processed food products export development authority of India (APEDA), 2022].

Agaricus bisporus requires two different substrates to form the fruiting bodies i.e. the compost for nutrition and the casing soil in which the suitable physicochemical/biological conditions stimulate the initiation process of pin head formation for fruit body production. In spite of being nutritionally deficient medium, casing layer plays an important role in the production of button mushroom. The casing layer is one of the important growing parameter and source of variation in production, quality and uniformity of commercial cropping (Kaur and Rampal, 2017).

The mushroom cultivation is the best option for landless farmer. The majority of people in India are landless and below poverty line (BPL). Protein is one of the nutrients that is included in balance diet for proper growth and development of humankind. The amount of food that is needed for human consumption is insufficient. A significant population in particular discovered a lack of protein in their diet and need to be added to diet (Kumar et al., 2023).

2. MATERIALS AND METHODS

Procurement of Spawn: This study investigates the spawn strain *Agaricus bisporus* (DMR NBS-5), procured from the Directorate of Mushroom Research, Chambaghat, Solan, Himachal Pradesh. The research aimed to evaluate the growth parameters and yield potential.

Compost Preparation: The primary material for compost preparation, wheat straw, was sourced from Dairy Farm. Additional ingredients included wheat bran, urea, potassium (Muriate of Potash),

phosphorus (Single Super Phosphate) and gypsum all obtained from commercial outlets. The compost was prepared using the long method of composting (Mantel et al., 1972).

Wetted wheat straw was spread thinly over entire floor of the composting yard and then gradually wetted by sprinkling water, till the straw was taken no more water. The straw was then turned for even wetting at the stage and water content was maintained at 75 per cent. The moist straw was mixed with wheat bran (15kg), single super phosphate (3kg), muriate of potash (3kg), urea (6kg) and calcium ammonium sulphate (9kg) uniformly scattered over the straw, known as zero day. A heap was made after each turning but not compressed tightly so as to maintain the aerobic condition in the compost heap. After first and second turning done. Gypsum was mixed at the third turning and at each turning water was sprayed to make up the loss of water due to evaporation. Same procedure is done in fifth and sixth turning. Profenofos insecticide was mixed at seventh turning for prevention of insects pests. Total eight turning was done and each turning at four days interval. The compost was then ready for spawning i.e. it was dark brown in colour and without any smell of ammonia and had sufficient moisture content (68-70%) when pressed between palms.

Spawning: For each treatment, including a control, a unit of 5 kg mildly wet compost was placed in perforated polypropylene bags, distributed across six treatments with seven replications each. The moisture content of the compost during spawning was maintained at 25-30%. Spawn was thoroughly mixed with the compost at a rate of 7.5 g/kg (Kapoor, 2004) and pressed moderately. To retain moisture, sterilized newspaper was placed on top of the compost bags, which were then folded and transferred to a dark room for the spawn run.

Preparation of casing mixtures: Farmyard manure was obtained from Dairy Farm, SHUATS. Cocopeat and sawdust were sourced from a commercial outlet in Prayagraj.

Turmeric powder preparation and supplemented in casing mixture: For this trial, turmeric powder was selected. Turmeric rhizomes were collected, sun-dried, and ground into a fine powder using a mortar and pestle, followed by a mixer. The dried turmeric powder was then mixed with the casing materials, including farmyard manure (FYM), cocopeat, and sawdust, were combined in a (1:1:1) ratio at varying concentrations of 0.5%, 1.0%, 1.5%, 2.0%, and 2.5% as per the treatments and replicated seven times. Untreated check bags were maintained as control. After complete mycelial colonization of the compost, treatment supplemented in casing materials were applied uniformly to a thickness of 3 cm on top of the compost, Pandey et al. (2007). The casing was lightly pressed, and a small quantity of water was sprayed on the surface. To minimize moisture evaporation. A total of 42 bags were arranged in a Completely Randomized Design (CRD) within a covered mushroom crop room. The bags were covered with sterilized newspapers. After casing application, the room temperature was maintained at 23±2°C with a relative humidity of 85-90% for an additional 8-10 days until casing run completion. Each bag received 0.5 to 1.0 liter of irrigation water every other day, adjusted based on the dryness of the casing material. The mushroom beds were regularly sprayed with water to ensure adequate moisture in the casing soil (Prasad and Singh, 2020).

Fruiting: Mycelium emergence on the casing soil was observed after 10 days. Subsequently, the environmental conditions in the cropping room were adjusted to promote optimal growth. Fresh air was introduced through ventilation, and light exposure was provided for 6-8 hours daily. Relative humidity was maintained at 90-95% by spraying water three times a day.

The temperature in the cropping room was held at 16±2°C. Additionally, a low CO_2 concentration of 0.08-0.15% was maintained, as this range is favorable for reproductive growth during this developmental stage.

Harvesting: Harvesting was done after the pinheads started turning into mature button sized fruiting bodies just before the cap expands and gills are exposed and are about to bulge. Harvesting was done by holding them gently and twisting them in clockwise and anti- clockwise directions without any residues of stub and without disturbing the other fruiting bodies. Soil particle and mycelium strands clinging to base are cut with a sharp knife (Rai and Saxena.,1989).

Observations recorded: Mycelium run on casing layer (days), Initiation of pinheads (days), Pileus diameter (cm), Stalk length (cm), Stalk diameter (cm), First harvest (days), Yield (g), Biological efficiency (%)

Biological Efficiency (%): Biological efficiency was calculated as follows: -

Biological efficiency = Total weight of fresh mushroom / Total dry weight of compost * 100

Cost benefit ratio: The cost benefit ratio was calculated using following formula:

C: B ratio = Gross returns / Total cost of cultivation

3. RESULTS

Days required for mycelium run, pinhead initiation and first harvest of *Agaricus bisporus:* The data presented in Table 1 revealed that minimum days taken for mycelium run in casing layer, pinhead initiation and first harvest was observed in T_4 [FYM + Sawdust + Cocopeat (1:1:1) + Turmeric powder @ 2 % (15.28), (17.29), (20.57)] followed by T_5 [Cocopeat + FYM +Sawdust (1:1:1) + Turmeric powder @ 2.5 % (15.71), (18.57), (22.71)], T_3 [FYM + Sawdust + Cocopeat (1:1:1) + Turmeric powder @ 1.5 % (16.57), (21.14), (25.71)], T_2 [FYM + Sawdust + Cocopeat (1:1:1) + Turmeric powder@ 1% (17.00), (21.85), (28.29)], T_1 [FYM + Sawdust + Cocopeat (1:1:1) + Turmeric powder@ 0.5% (17.71), (22.57), (28.71)] and T_0 [FYM + Sawdust + Cocopeat (1:1:1) (18.71), (24.71), (30.14)].

Stalk length (cm), stalk diameter (cm), pileus diameter (cm) of *Agaricus bisporus:* The data presented in Table 1 revealed that maximum stalk length (cm), stalk diameter (cm), pileus diameter (cm) of fruiting bodies was observed in T_4 [FYM + Sawdust + Cocopeat (1:1:1) + Turmeric powder@ 2% (3.32), (2.36), (4.87)] followed by T_5 [Cocopeat + FYM +Sawdust (1:1:1) + Turmeric powder@ 2.5% (3.10), (2.03), (4.46)], T_3 [FYM + Sawdust + Cocopeat (1:1:1) + Turmeric powder@1.5% (2.64), (1.58), (3.71)], T_2 [FYM + Sawdust + Cocopeat (1:1:1) + Turmeric powder@ 1% (2.29), (1.49), (2.65)], T_1 [FYM + Sawdust + Cocopeat (1:1:1) + Turmeric powder@ 0.5% (1.87), (1.30), (2.45)] and T_0 [FYM + Sawdust + Cocopeat (1:1:1) (1.47), (1.12), (1.79)].

Weight of fruiting body (g) and average yield (g) of *Agaricus bisporus:* The data presented in Table 1 revealed that maximum fruiting bodies weight (g) and yield (g) was observed in T_4 [FYM + Sawdust + Cocopeat (1:1:1) + Turmeric powder@ 2% (12.37), (583.33)] followed by T_5 [Cocopeat + FYM +Sawdust (1:1:1) + Turmeric powder@2.5% (11.97), (528.54)], T_3 [FYM + Sawdust + Cocopeat (1:1:1) + Turmeric powder@ 1.5 (10.65), (477.58)], T_2 [FYM + Sawdust + Cocopeat (1:1:1) + Turmeric powder@ 1% (10.13), (360.65)], T_1 [FYM + Sawdust + Cocopeat (1:1:1) + Turmeric powder@ 0.5% (9.99), (313.08)] and T_0 [FYM + Sawdust + Cocopeat (1:1:1) (9.15), (251.05)].

Table 1. Effect of casing mixtures along with turmeric powder on the growth parameters and yield of white button mushroom (*Agaricus bisporus)*

Tr. No.	Treatments name	Case run (days)	Pinhead initiation (days)	Pileus diameter (cm)	Stalk length (cm)	Stalk diameter (cm)	Wt. of fruiting body	First harvest (days)	Yield (g)	BE (%)	C:B ratio
T0	FYM + CCP + SD (1:1:1)	18.71^{a}	24.71^{a}	1.79^{e}	1.47^{e}	1.12^{e}	9.15^{e}	30.14^{a}	251.05^{f}	5.77^{f}	1:0.88
T1	FYM + CCP + SD (1:1:1) + TP@ 0.5%	17.71^{b}	22.57^{b}	2.45^{d}	1.87^{d}	1.30^{d}	9.99^{d}	28.71^{b}	313.08^{e}	7.45^{e}	1:1.34
T2	FYM + CCP + SD (1:1:1) + TP @ 1 %	17.00^{c}	21.86^{bc}	2.90^{d}	2.29^{c}	1.49^{c}	10.13^{d}	28.29^{b}	360.65^{d}	8.58^{d}	1:1.68
T3	FYM + CCP + SD (1:1:1) + TP@ 1.5%	16.57^{c}	21.14^{c}	3.71^{c}	2.64^{b}	1.58^{c}	10.65^{c}	25.71^{c}	477.38^{c}	11.36^{c}	1:2.55
T4	FYM + CCP + SD (1:1:1) + TP @ 2 %	15.28^{d}	17.29^{d}	4.87^{a}	3.32^{a}	2.36^{a}	12.37^{a}	20.57^{d}	583.37^{a}	13.56^{a}	1:3.33
T5	FYM + CCP + SD (1:1:1) + TP @2.5%	15.71^{d}	18.57^{e}	4.46^{b}	3.10^{a}	2.03^{b}	11.97^{b}	22.71^{e}	528.55^{b}	12.31^{b}	1:2.92
	SEM	0.19	0.27	0.10	0.10	0.04	0.07	0.24	2.77	0.10	
	CD (0.05)	0.55	0.77	0.31	0.29	0.12	0.21	0.77	8.20	0.28	

Tr no. = Treatment Number, FYM = Farm Yard Manure, CCP = Coconut Coir Pith, SD = Sawdust, TP = Turmeric Powder, BE = Biological Efficiency, C: B = Cost Benefit Ratio

Biological efficiency (%) and C:B ratio of *Agaricus bisporus:* The data presented in Table 1 revealed that maximum biological efficiency (%) was observed in T_4 [FYM + Sawdust + Cocopeat (1:1:1) + Turmeric powder@ 2% (13.56)] followed by T_5 [Cocopeat + FYM +Sawdust (1:1:1) + Turmeric powder@2.5% (12.31)] and minimum biological efficiency (%) in T_0 [FYM + Sawdust + Cocopeat (1:1:1) (5.77)].

Maximum C:B ratio was observed in T_4 [FYM + Sawdust + Cocopeat (1:1:1) + Turmeric powder@ 2% (1:3.33)] followed by T_5 [Cocopeat + FYM +Sawdust (1:1:1) + Turmeric powder@2.5% (1:2.92)] and minimum C:B ratio in T_0 [FYM + Sawdust + Cocopeat (1:1:1) (1:0.88)].

4. DISCUSSION

The probable reasons for such findings may be that turmeric contains 3-6% polyphenolic compounds, collectively known as curcuminoids, which is a mixture of curcumin, demethoxycurcumin and bisdemethoxycurcumin which are major components responsible for various biological actions and have many other important compounds which have antifungal properties (Niranjan and Prakash, 2008). And the physical and chemical properties and microbiological components of casing material i.e. in physical properties the water holding capacity, bulk density and porosity, the three main attributes of good casing soil were comparatively higher in casing material of farm yard manure (2 years old) and in regards of chemical properties the casing mixture with higher moisture content had low electrical conductivity values and the pH for casing mixtures was found to be range of 7.5-7.9. The cocopeat has a neutral pH and because of its organic content and granular structure, stays porous even after a succession of watering, holds moisture, allows appropriate gaseous exchanges and supports microbial population able to release hormone-like substances which are likely involved in stimulating the initiation of fruit bodies (Eger,1972; Hayes,1981), in regards of physical properties of sawdust it was observed that sawdust have good porosity, water retention, and water drainage (Raina, P. K., et al., 2003). These may have reduced the incidence of green mould, dry bubble and wet bubble diseases and enhances the mycelium run and pin head initiation of *Agaricus bisporus*. These may have also suppressed the growth of mycoflora which may have favoured the fast growth of *Agaricus bisporus* mycelium. Turmeric at concentration (2%) promoted faster mycelial run and thus resulted in requiring least days for mycelium run. The increasement of weight of fruiting bodies, stalk length, stalk diameter and pileus diameter of *Agaricus bisporus.* Turmeric at concentration 2% shows significant increase of weight of fruiting bodies, enhances stalk length, stalk diameter and pileus diameter. These results were also observed at 2.5% concentration but it also inhibited the growth of mold fungus as well as *A. bisporus.* Similar findings have been reported by (Altaf et al., 2022) in which the *in vivo* evaluation of botanicals at 2% concentration of *C. longa* had the highest average weight (11.8–11.9 g) of a single fruit body and a combined button yield of 11.3–11.9 kg/quintal compost. An interesting similar result find by Prasanth et al. (2021).

5. CONCLUSION

Casing mixture of FYM + Cocopeat + Sawdust (1:1:1) + Turmeric powder @ 2 % concentration recorded minimum days for spawn run and pinhead initiation of *Agaricus bisporus* (White button mushroom). Casing mixture of FYM + Cocopeat + Sawdust (1:1:1) + Turmeric powder @ 2 % concentration had the maximum pileus diameter (cm), stalk length (cm), stalk diameter (cm), maximum yield (g) and biological efficiency (%). The results of cost benefit ratio among the treatments were recorded and concluded that casing mixture of FYM + Cocopeat + Sawdust (1:1:1) @ Turmeric powder at 2% recorded highest C:B ratio (1:3.33). The results of the present study are of one crop season (October 2023- March 2024) under Prayagraj agroclimatic conditions as such more trials should be carried out in future to validate the present findings.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

Agricultural and processed food products export development authority of India (APEDA), 2022. (www.apeda.in).

Altaf, S., Jan, S. K., Basu, U., Ahanger, S. A., Dave, A., Kakraliya, S. S., Baazeem, A., Mishra, A. K., Kumar, A., Shah, I. A. and Mushtaq, M. (2022). Sustainable management of green mold disease of white button mushroom using botanicals and biocontrol agents under temperate conditions. *Horticulturae*. 8: 768.

Eger, G. (1972). Experiments and comments on the action of bacteria on sphorophore initation in *Agaricus bisporus*. *Museum Science*. 8: 719-725.

FAOSTAT. (2023). Mushroom production in the world. FAOSTAT website.

Food and Agriculture Organization (FAO), 2023. (www.fao.org)

Hayes, W. A. (1981). Interrelated studies of physical, chemical and biological factors in casing soils and relationships with productivity in commercial culture of *Agaricus bisporus*. *Museum Science*. 11: 103-129.

Kapoor, J. N. (2004). Mushroom cultivation. Department of Mycology and Plant Pathology, IARI, New Delhi. 4-6.

Kaur A.P, Rampal V.K. (2017). Assessment of Casing Mixtures on Yield Potential and Quality of Button Mushroom (*Agaricus Bisporus*) – On Farm Trial. *International Journal of Current Microbiology Applied Science*. 6(2): 430-436.

Kumar, P., Kumar, V., Eid, L. M., Al-Huqail, A. A., Adelodun, B., Abou Fayssal, S. and Siric, I. (2022). Spatial assessment of potentially toxic elements (PTE) concentration in *Agaricus bisporus* mushroom collected from local vegetable markets of Uttarakhand state, India. *Journal of Fungi*. 8(5): 452-459.

Kumar, S., Chandra, R., Lal, K., Kumar, A. and Kumar, V. (2023). Evaluation of different doses basis micronutrient and growth regulator against growth behaviours and yield perspective of oyster mushroom. *Pleurotus florida* (Mont.) Singer. *Annals of Phytomedicine*. 12(1): 1-8.

Mantel, E. F. K., Agrawal, R. K. and Seth, P. K. (1972). A guide to mushroom cultivation. Ministry of Agriculture, Farm Information Unit, Directorate of Extension, New Delhi, Farm Bull. No.2.

Netam, R. S., Yadav, S. C., Mukherjee, S. C. and Kumari, P. (2018). Cultivation of Button Mushroom (*Agaricus bisporus*) Under Controlled Condition: An Initiative in Bastar Plateau of Chhattisgarh. *International journal of current Microbiology and Applied Sciences*. 7(10): 782 – 787

Niranjan, K., and Prakash, J. (2008). Chemical constituents and biological activities of turmeric (*Curcuma longa L.). Journal of Food Science and Technology.* 45(2):109-116.

Pandey, M., Pandey, U. N., Verma, N. and Shukla, H. P. (2007). Yield response of *Agaricus bisporus* in relation to different casing thickness. *Progressive Agriculture*. 7(2): 172.

Prasad, D. and Singh, R. (2020). Button mushroom (*Agaricus bisporus)*: composting and cultivation technology. pp: 20-22.

Prasanth, M., Simon, S. and Thessy, C. R. (2021). Effect of botanicals in combination with wheat straw on the growth of oyster mushroom (*Pleurotus florida*). *International Journal of Current Microbiology and Applied Sciences*. 10(04), 297-301.

Rai, R. D. and Saxena, S. (1989). Biochemical changes during postharvest storage of button mushroom (*Agaricus bisporus*). *Current Science*. 58: 508-510.

Raina, P. K., Tikoo, M. L. and Kalha, C. S. (2003). Management of *Trichoderma* green mould in the white button mushroom, *Agaricus bisporus* (Lange) Sing. with botanical extracts. *Mushroom Research*. 12(1): 39-42.

Sharma, V. P., Annepu, S. K., Gautam, Y., Singh, M. and Kamal, S. (2017). Status of mushroom production in India. *Mushroom research*. 26(2): 111-120.

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