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Formulating Different Casing Mixtures and Implementing them to Check their Effect on *Agaricus bisporus* Yield

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Abstract: In the present study, five different casing mixtures—Farm Yard Manure (FYM), Garden Soil (GS), Spent Compost (SC), Sandy Soil (SS), and Local Soil (LS)—were evaluated for their effectiveness in the cultivation of *Agaricus bisporus* to enhance yield. Each casing mixture was subjected to three treatments: treatment with 4% formalin solution, autoclaving at 15 psi, and an untreated control. Among the five casing materials tested, FYM was found to be the most effective, providing optimal conditions for mushroom development. This was evidenced by the shortest time to pinhead formation (18.4 days), longest stipe length (2.5 cm), largest cap diameter (3.1 cm), and the highest yield (14.7 kg per 100 kg compost). Furthermore, among the treatment methods, FYM treated with 4% formalin yielded the highest production (16.7 kg per 100 kg compost), significantly outperforming all other combinations.

Key words: *Mushroom, Casing, Composting, Agaricus bisporus, Farm Yard Manure.*

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I. INTRODUCTION

'The most widely grown mushroom in the world is *Agaricus bisporus* (Lange) Sing., also referred to as the white button mushroom' (Wood & Fermor, 1985). Approximately 90% of India's entire mushroom production currently comes from this type of mushroom (Tewari, 2005). A particular growing media or substrate is not suitable in all the season or all states. 'In many tropical countries like India, different types of mushrooms can thrive in a range of temperature conditions, making them perfect for year-round growing' (Dehariya and Vyas, 2013). Chaddha and Sharma (1995) stated that 'white button mushroom cultivation is mostly restricted to small, seasonal growing units that use mostly unpasteurized compost and produce 10–14 kg of mushrooms per quarter of compost; However, a small number of commercial growing units have harvested 18–22 kg of mushrooms per quart of compost using pasteurized compost under controlled conditions, and in developed nations, the production is 25–30 kg of mushrooms per quart of compost'.

'In the commercial production of mushrooms, the casing is applied over the compost, typically after the substrate has been fully colonized by mushroom mycelium, to promote fruiting, various materials have been utilized for casing, either individually or in mixtures, in both experimental and commercial settings, though very few have proven effective for practical use; The choice of a specific casing material is influenced by its impact on yield and quality, along with factors like availability and cost' (Mehta *et al*., 2015). 'Sphagnum peat moss' is a widely used component of casing mixtures in North America and Europe (Goglio *et al*. 2023). Pardo *et al* (1999) suggested that besides peat moss, commonly used natural materials of mineral origin include soil, gravel, tuffeau stone, various forms of calcium carbonate, and spent compost from *Agaricus bisporus*. Jarial and Shandilya (2005) stated that despite being low in nutrients, the 'casing layer' is crucial for the yield of button mushrooms, numerous materials have been evaluated and utilized as casing soil; Nevertheless, the mixture of farmyard manure (FYM) and loam soil in a 1:1 volume ratio is commonly used as the standard casing material for cultivating *A. bisporus* in India. Atkins (1974) suggested that casing soil should have good water holding and releasing capacity without sealing effect.

'*A. bisporus* needs two distinct substrates to develop its fruit bodies, the compost where it grows vegetatively and the low-nutrient casing soil that provides the appropriate physical, chemical, and biological conditions necessary for initiating the process of fruit body formation' (Segula *et al*.,1987). 'The casing layer is an essential part of the total substrate in the artificial culture of *A. bisporus*' (Ram and Kumar, 2010). While various materials can serve adequately

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as a casing layer, peat is often considered the best option; Due to its distinct properties for retaining water and providing structure, it is widely recognized as ideal for casing purposes, also peat has a neutral pH, and due to its high organic matter content and granular structure, it remains porous even after multiple waterings, retains moisture, permits proper gas exchange, and supports a microbial community that likely produces hormone-like substances involved in triggering the growth of fruit bodies. (Eger, 1972; Hayes, 1981; Hayes *et al.*, 1969).

II. MATERIAL AND METHODS

➤ *Composting*

The primary component for synthetic compost, wheat straw, was sourced from Agro farms. Additional ingredients such as wheat bran, sawdust, ammonium sulfate, super phosphate, and gypsum were procured from commercial suppliers. The compost was prepared by the 'long method of composting' (LMC) which was first advocated in India by Mentel *et al* (1972). Initially, the base material (wheat straw) is thoroughly combined with fertilizers using forks. The mixture is then placed into a rectangular mold. Monitoring of the temperature begins at this stage. It starts to rise within 24-48 hours after stacking and can reach up to 65-70°C in the center. If the moisture level in the compost mixture is low, additional water is added. Watering is halted once leaching begins at the bottom of the pile. The first turning is performed on the sixth day to ensure that every section of the pile receives an equal amount of aeration and moisture. The second turning occurs on the tenth day, where the pile is broken open and turned. The third turning takes place on the thirteenth day, adding the necessary quantity of gypsum at this time. The fourth turning happens on day 16 to check for nematodes, with Furadan being added. The fifth turning is conducted on day 19, followed by the sixth turning on day 22. The seventh turning occurs on day 25, with the required amount of BHC being added. On the 28th day, the pile is dismantled to assess the presence of ammonia. If ammonia is absent, the mixture is then bagged.

Table 1 Ingredients of compost

S.No.	Constituent	Composition (in Kg)
1.	Wheat straw	300
2.	Wheat bran	30
3.	Saw dust	10-12
4.	Ammonium sulphate	9
5.	Super phosphate	2.4
6.	Gypsum	30

➤ *Spawning*

For spawning, completely colonized and fresh spawn was used. Spawn was thoroughly mixed @ 4% of the wet weight of the substrate before filling in the composted bags. 7 days later, bags were gently shake up, it gives a quicker spawn-run by distributing the inoculum and dispersing ammonia in the bags.

➤ *Casing*

In this process, after the spawn-run the beds are cased with appropriate mixture of soil and organic matter to create conditions which induce fructification. After 10-15 days spawning, casing was done. Five casing mixtures viz. Farm yard manure (FYM), Garden soil (GS), Spent compost (SC), Sandy soil (SS) and Local soil (LS) were used for casing and each casing mixture was given three different treatments i.e. untreated (control), chemically treated with 4 percent formalin and autoclaved at 15 psi pressure.

➤ *Procedure of casing*

Casing was performed by opening the bags once the mycelium fully colonized the compost. The compost surface was then levelled by pressing it with hand and a casing layer approximately 3-4 cm thick was evenly spread across the entire compost surface. A very light spray of formalin (0.5%) was applied after the casing. The temperature of the cropping room was kept at 23 + 2°C for about a week to allow the mushroom mycelium to extend into the casing layer. The casing layer serves as an insulating blanket that retains the heat generated in the compost. To eliminate the excess heat produced during this phase, especially when supplementation occurred, ventilation and air recirculation were necessary to sustain the desired temperature. In approximately a week, the mycelium distributes throughout the casing soil. During this phase, the temperature in the cropping rooms and beds was maintained between 14 and 18°C. It then rises, surpassing 25°C during the cropping stage. The relative humidity in the cropping room was kept at 85-90%.

III. RESULTS

The information displayed in table (1.2), illustrates how various casing mixtures and their treatments influence the yield of *Agaricus bisporus*. A combination of five casing mixtures was evaluated to determine their impact on the growth and yield of *Agaricus bisporus*, with each mixture receiving three distinct treatments: one treated with 4 percent formalin, another autoclaved at 15 psi, while the untreated mixtures served as the control. The yield of *Agaricus bisporus* (Kg/100 Kg compost) influenced by various casing mixtures and treatments is shown in table (1.2). An examination of the different casing mixtures and treatments clearly indicated that the yield of *Agaricus bisporus* fluctuated depending on the casing used. Among the five casing mixtures studied, 'FYM' emerged as the most effective casing material as it needed the shortest average duration for pinhead initiation (18.4 days), produced a greater stipe length (2.5 cm), a cap diameter of (3.1 cm), and achieved a notably higher yield of (14.7 Kg/100 Kg compost). The spent compost demonstrated the same period for pin head initiation (18.4 days), with a stipe length of (2.4 cm), a cap diameter of (3.0 cm), resulting in a yield of 13.7 Kg/100 Kg compost. The local soil required the

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maximum duration (20.8 days)

The findings indicated that untreated or control casing materials showed a shorter duration for pin head emergence; however, their fruiting body growth and yield were not as impressive as those of the treated materials. The time it took for pin head emergence ranged from 18.0 to 20.8 days depending on the different casing mixtures. The shortest time for pin head emergence was observed with FYM and SP, where it ranged from 18.0 to 19.7 days, followed by SS, GS, and LS in that order. The longest duration for pin head emergence was noted with local soil (LS), which varied from 19.7 to 22.7 days, reaching a maximum of 22.7 days when local soil was treated with formalin at 15 psi. The casing mixture FYM treated with 4 percent formalin solution required time for pin head appearance (19.7 days), stipe length (2.5 cm.), cap diameter (3.1 cm) and significantly highest yield 16.7 Kg /100 Kg compost.

The casing mixtures sterilized by steam were found to be superior over control, however, these were found to be inferior to formalin in terms of yield. Yields for all the treatments in different casing mixtures varied from 11.0 to 16.7 Kg /100 Kg. All the casing mixtures treated with 4 percent formalin gave the significantly higher yield followed by casing mixture autoclaved at 15 psi. Analysis of the performance of untreated casing mixture revealed that both the treatments were distinctly superior than that of it as it gave significantly lower yield in all the casing mixtures studied. The untreated LS and GS gave significantly lower yield i.e. 10.0 Kg/100 Kg and 11.0 Kg /100 Kg, respectively.

Table 2 Impact of Casing Mixtures and their Treatments on the Yield of *Agaricus bisporus*.

Casing mixture	Treatment	Pinhead initiation (days)	Stipe length (cm.)	Cap diameter (cm.)	Yield (Kg./100 kg compost)
Farm Yard Manure (FYM)	C	18.0	2.4	2.9	12.0
	F	19.7	2.5	3.1	16.7
	A	18.4	2.6	3.2	15.3
	Mean	**18.4**	**2.5**	**3.1**	**14.7**
Garden Soil (GS)	C	18.4	2.3	2.7	11.0
	F	20.7	2.4	2.9	14.7
	A	20.0	2.5	3.1	13.0
	Mean	**19.7**	**2.4**	**2.9**	**12.9**
Spent Compost (SC)	C	18.4	2.3	3.0	11.3
	F	19.4	2.4	3.0	16.0
	A	18.7	2.5	3.1	13.7
	Mean	**18.4**	**2.4**	**3.0**	**13.7**
Sandy soil (SS)	C	19	2.2	2.7	11.0
	F	19.7	2.3	2.8	14.0
	A	19	2.5	2.9	12.7
	Mean	**19.2**	**2.3**	**2.8**	**12.6**
Local soil (LS)	C	19.7	2.2	2.9	10.0
	F	22.7	2.3	3.0	14.0
	A	20.0	2.5	3.2	11.3
	Mean	**20.8**	**2.3**	**3.0**	**11.8**
CD(P=0.05%)	**Casing mixture (a)**		0.07	0.08	1.0
	Treatment (b)		0.06	0.06	0.8
	Interaction (a×b)		0.13	0.14	1.7

F- formalin, A- autoclaved at 15 lbs, C- control (without treatment)

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➢ *Values are Given in an Average of Three Replicates*

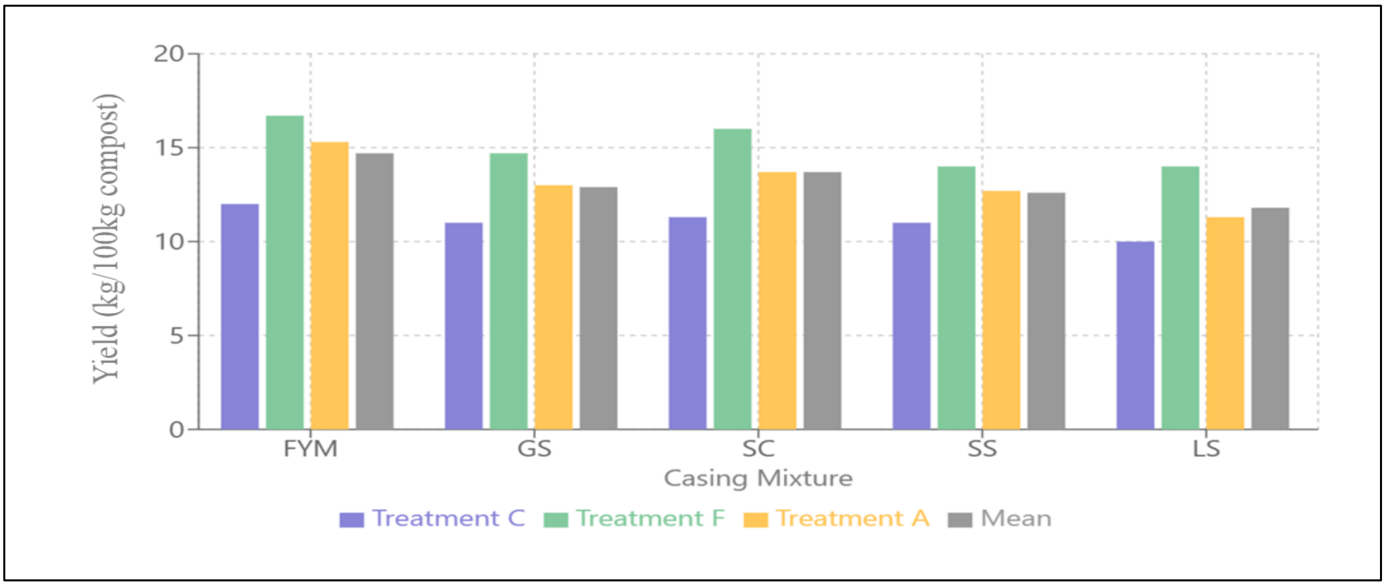

Fig 1 Yield Comparison Across Casing Mixtures and Treatments

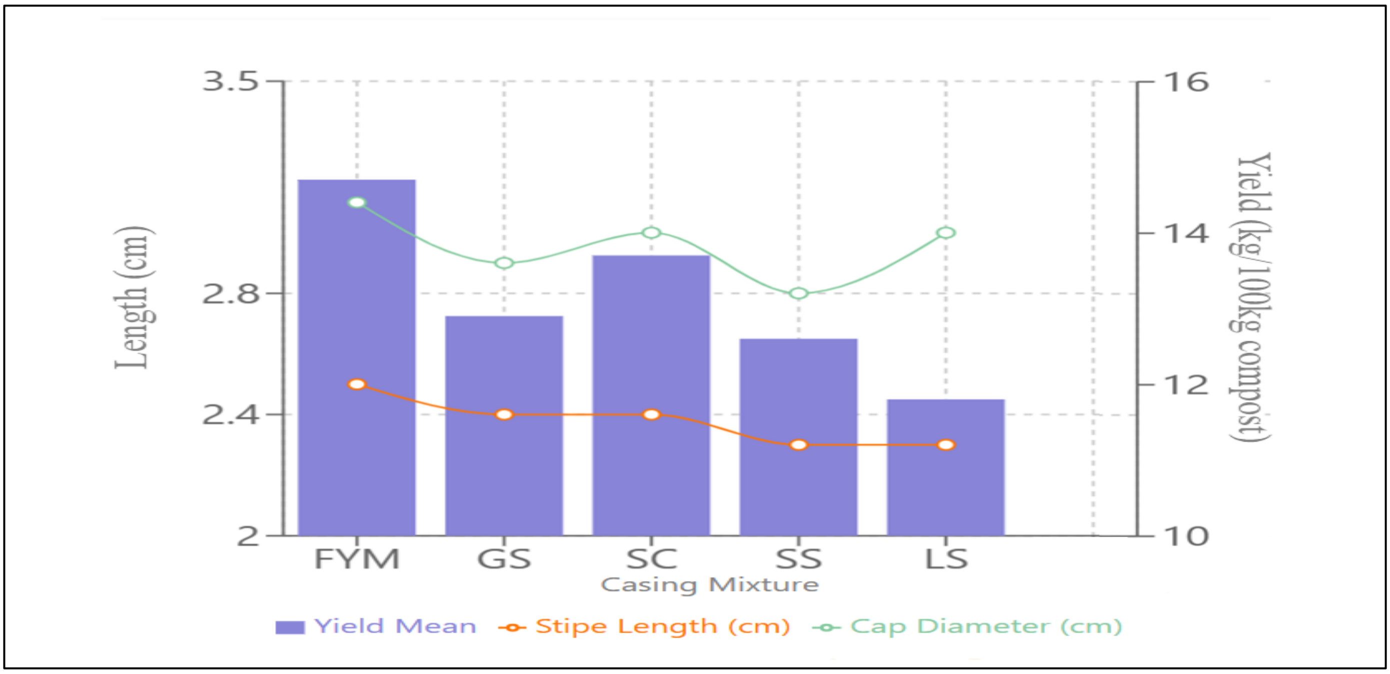

Fig 2 Effect of casing mixture and treatments on stipe length and cap diameter

IV. DISCUSSION

The process of applying casing layer over the compost bed is called 'casing' (Pandey, 2008). Tandon *et al* (2006) stated that 'casing' refers to the agronomic technique of covering the upper layer of mushroom beds with a suitable soil mixture after the spawn run (Tandon *et al*., 2006). 'The advantages of casing' are as follows: it creates a surface conducive to consistent fructification, acts as a water reservoir for emerging mushrooms, supports the growth of beneficial bacteria that are crucial for triggering fruiting, reduces water loss from mushroom compost and alters the diffusion rate of metabolic gases, which are important for primordium development and mushroom growth (Paul *et al*., 1996).

Different casing materials have been evaluated in India as well as abroad. For casing, 'spent compost' has been recommended by Mantel (1973), Hayes *et al*., (1976) and Hayes and Shandilya (1977). Shandilya and Agrawal (1983) employed a blend of 'farmyard manure' mixed with various proportions of spent compost. Singh *et al*., (1985) also applied 'farm yard manure', 'spent compost' and 'field soil' in different ratios for casing. The compactness of casing medium hampers the passage of air from compost to casing layer and vice-versa. High concentration of carbon dioxide during cropping period reported watering, affected the yield (Visscher, 1975). Flegg (1975) used normal synthetic compost incorporating spent materials for casing and also noted the importance of pore space in casing medium.

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Vijay *et al.,* (1988) reported "the effect of casing thickness on yield of *Agaricus bisporus".* Kassim *et al.,* (1990) reported "the effect of casing soil amendments and nutrient supplementation on mushroom cropping". Gülser and Peken **(**2003) reported "used tea waste as a new casing material for *Agaricus bisporus* growth". Colak (2004) reported "the use of peat as a casing material with different combinations with pertile. Sassine *et al.,* (2005) reported "waste paper as a casing material". Sharma *et al.,* (2005) reported "the nutritional requirement of casing soil bacteria of white button mushroom *Agaricus".* Bhatt *et al.,* (2006) reported the "physiochemical properties of different casing mixtures and its effect on yield of *Agaricus bisporus".* Dhar *et al.,* (2006) reported "casing material related to button mushroom yield". Royse *et al.,* (2007) reported "re-supplementing and re-casing of *Agaricus bisporus* compost for second crop". Ram and Kumar (2010) reported "agricultural wastes as casing mixtures for production of *Agaricus bisporus".* Munshi *et al.,* (2012) evaluated "different strains of *Agaricus bisporus* for higher yield". Dehariya *et al.,* (2013) used different four type of composts for the growth of *Agaricus bisporus*.

The current study indicates that FYM offers an adequate concentration of CO2 needed for the initiation of fruit bodies when compared to other casing materials. Additionally, FYM provides favorable aeration for the survival of microorganisms, which is essential for casing. In contrast, SC also offers good aeration and has a compact structure, making it effective in terms of yield. On the other hand, SS and LS have a loose structure, which does not supply enough CO2 concentration for the initiation of fruit bodies, leading to a situation where many primordia fail to penetrate the casing substrate, resulting in a comparatively lower yield and requiring a longer time for pinhead emergence.

REFERENCES

[1] Atkins, F.C. (1975). Industrial waste compost and salts in the casing layer. *Mushroom J.* 32:269-270.

[2] Bhatt, P., Kushwaha, K.P.S. and Singh, R.P. (2006). Physiochemical properties of different casing mixtures and its effect on yield of *Agaricus bisporus. Mushroom Research*, 15: 29-32.

[3] Chaddha, K.L. and Sharma, S.R. (1995). In: Recent Advances in Horticulture. Vol.13 Malhotra Publishing House, New Delhi.

[4] Colak ,M. (2004). Temperature profiles of *Agaricus bisporus* in composting stages and effects of different composts formulas and casing materials on yield. *African Journal of Biotechnology*. 3: 456-462.

[5] Dehariya P and Vyas D (2013). Seasonal productivity and morphological variation in *Pleurotus sajor-caju International journal of Recent Scientific Research.* 4 (12) 1983-1986.

[6] Dehariya P, Vyas D, Kashaw S (2013). Mushroom neutraceuticals on different substrates. *International Journal of Pharmacy and Pharmaceutical Sciences*.5 (04): 88-90.

[7] Dhar, B.L., Ahlawat, O.P., Gupta, P. and Dev R. (2006). Casing layer as related to mushroom yield and quality in *Agaricus bisporus* in India. *Mushroom Research.* 15: 111-117.

[8] Eger G (1972). Experiments and comments on the action of bacteria on sphorophore initation in *Agaricus bisporus*. Mush. Sci. 8: 719- 725.

[9] Flegg, P.B. (1975). Some thoughts on recycling compost and casing. *Mushroom J.* 32: 282-284.

[10] Goglio, P., Ponsioen, T., Carrasco, J., Tei, F., Oosterkamp, E., Pérez, M., ... & Pyck, N. (2025). Environmental impact of peat alternatives in growing media for European mushroom production. *Science of the Total Environment*, *964*, 178624.

[11] Gülser, U.C.K. and Peken, A. (2003). Using tea waste as a new casing material in mushroom (*Agaricus bisporus* (L.) Sing.) cultivation. *Bioresource Technology*. 153-156.

[12] Hayes, W.A. and Shandilya, T.R. (1977). Casing soil and compost substrates used in the artificial culture of *Agaricus bisporus* the cultivated mushroom. *Indian J. Mycol. Pl. Pathol*.7: 5-10.

[13] Hayes, W.A. and Shandilya, T.R., Munjal, R.L. and Seth, P.K. (1976). Improvement to the soil used as casing media in Himachal Pradesh. *Ind. J. Mush*.2 (2): 29-32.

[14] Hayes WA (1981). Inter-relation studies of physical, chemical and biological factors in casing soils and relationships with productivity in commercial culture of *Agaricus bisporus* Lang. *Plant. Mushroom Sci.* 11(1): 163 -179.

[15] Hayes WA, Randle PE, Last FT (1969). The nature of the microbial stimulus affecting sporophore formation in *Agaricus bisporus* (Lange) Sing. *Ann. Appl. Biol.* 64: 177-187.

[16] Jarial, R.S. and Shandilya, T.R. (2005). Mushroom yield and quality characteristics as influenced by various casing materials in *Agaricus bisporus. Mushroom Research*, 14: 64-67.

[17] Kassim, M.Y., Khaliel, A.S. and Al-Rahman, A.N. (1990). Effect of casing soil amendments and nutrient supplementation on mushroom cropping. *J. King Saud. Univ*. 2: 225-230.

[18] Mantel, E.F.K., Agrawal, R.K. and Seth, P.K. (1972). Aguide to mushroom cultivation. Ministry of Agriculture Farm Information Unit, Directorate of Extension, New Delhi, Farm Bull no.2.

[19] Munshi, N.A., Kauser, S.,Rehman, S.U., Teli, M.A. and Peerzada, S.H. (2012). Evaluation of different strains of *Agaricus bisporus* for higher yield and other quality character under Kashmir conditions. *Mushroom Research*: 21 (2): 165-166.

[20] Mentel, E.F.K. (1973). Casing soil made from spent compost. *Ind. J. Mush*.1: 15-16.

[21] Mehta, B. K., Jain, S. K., Sharma, G. P., Doshi, A., & Jain, H. K. (2011). Cultivation of button mushroom and its processing: an techno-economic feasibility. *International Journal of Advanced Biotechnology and Research*, *2*(1), 201-207.

[22] Pardo, A., Pardo J.E., De Juan J.A., 1999. Cobertura y fructificación del champiñón cultivado, *Agaricus bisporus* (Lange) Imbach: materiales y aspectos prácticos. In: Avances en la tecnología de la

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producción comercial del champiñón y otros hongos cultivados. Patronato de Promoción Económica-Diputación Provincial de Cuenca, Cuenca, Spain. pp. 101-130 [In Spanish].

[23] Ram, R. C., & Kumar, S. (2010). Agricultural wastes used as casing mixtures for production of button mushroom. *Indian Journal of Scientific Research*, *1*(1), 21-25.

[24] Ram, R.C. and Thakur, D. (2005). Evaluation of new substrate preparation techniques for Oyster mushroom cultivation. *Mushroom Research*.14: 37-39.

[25] Royse, D. J. Sanchez, J. E., Beelman, R. B. and Davidson, J. (2007). Re-supplementing and re-casing mushroom (*Agaricus bisporus*) compost for a second crop. *World J. of Microbiology and Biotechnology*. 24: 319-325.

[26] Sassine, Y.N. Ghora, Y. Kharrat, M. Bohme M. and A.M.R Abdel-Mawgoud Waste. (2005). Paper as an Alternative for Casing Soil in Mushroom (*Agaricus bisporus*) Production. *Journal of Applied Sciences Research*. 1: 277-284.

[27] Segula M, Levanon D, Danai O, Henis Y (1987). Nutritional supplementation to the casing soil: Ecological aspects and mushroom production. Mushroom Science XII Proceedings of the Twelfth International Congress on the Science and Cultivation of Edible Fungi, pp. 417-426.

[28] Sharma, M., Shah, R. and Doshi, A. (2005). Nutritional requirement of casing soil bacteria of white button mushroom *Agaricus bisporus J. Mycol. Pl. Pathol*. 84-86.

[29] Singh, R. N, Bhandari, J.P.S. and Kanaujia, J.P. (1985). Effect of different casing media on the yield of button mushroom. *Ind. Phytopath*. 38: 502-506.

[30] Shandilya, T.R. and Agrawal, R.K. (1983). Evaluating farm yard manure and spent compost as casing substrate in the cultivation of *Agaricus bisporus. Indian J. Plant Pathology:* 1: 34-37.

[31] Tandon, G., Sharma, V.P. and Jandaik, C.L. (2006).Evaluation of different casing materials for *Calocybe indica* cultivation. *Mushroom Research*.15: 35-37.

[32] Tewari, R.P. (2005). Mushrooms, their role in nature and society. In: Frontiers in Mushroom Biotechnology. Rai, R.D., Upadhyay, R.C. and Sharma, S.R. eds.pp 1-8.. National Research Centre for Mushrooms, Soaln, India.

[33] Vijay, B., Gupta, Y. and Sohi, H. S.(1988). Effect of casing thickness on yield of *Agaricus bisporus*. *Indian Mycol. Pl. Pathol*.18: 209-210.

[34] Wood, D. A., and T. R. Fermor. "Nutrition of Agaricus bisporus." The biology and technology of the cultivated mushroom (1985): 43-61.