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Effects of Substrate Composition on Growth Parameters of Two *Volvariella* Species

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Abstract: ***Mushrooms have the ability to degrade and convert different agro-wastes into valuable products. Environmental contaminations can be ameliorated by the application of mushroom mycelial technologies, that is by the use of bioconversion processes to transform unwanted substances into valuable food stuffs by the proper treatment and reutilization of spent substrates. It has been observed that over 70% of agricultural and forest products have not been put to total productivity, and has been discarded as waste. Mushrooms can convert these huge ligno-cellulosic biomass wastes into useful products, the palatable forms of food protein. The study investigates the influence of substrate composition on the growth parameters of two Volvariella species, V. volvaceae and V. diplasia. Rice straw, sugarcane bagasse, and their combinations were used as substrates for mushroom cultivation. The results showed that rice straw emerged as the most favorable substrate for both species. The study highlights the potential of rice straw as an ideal substrate for Volvariella cultivation, providing essential nutrients and suitable physical conditions for optimal growth and fruiting. The utilization of rice straw aligns with circular economy principles, transforming agricultural waste into a valuable resource for food production. The findings have significant commercial implications for mushroom farmers, potentially reducing production costs, increasing yields, and diversifying mushroom production. The successful cultivation of Volvariella species on rice straw presents opportunities for enhancing food security and sustainable agriculture practices.***

Keywords: Mushroom, *Volvariella*, Straw, Sugarcane baggasse, Substrate

1. Introduction

Inadequate regional food supplies, diminishing quality of health, and increasing environmental deterioration are three key underlying problems affecting the future well-being of humankind. The magnitude of these problems is set to increase as the world' population continues to grow. Mushroom biology offer partial but meaningful solutions for this problem through the generation of relatively cheap source high quality food protein. Mushrooms constitute a most rapidly growing new food category which the current health oriented public is increasingly enjoying. Wastes such as cereal straws and sugarcane residues are largely burnt by the farmers, which causes air pollution. However, these raw materials can actually be used for the cultivation of mushrooms. This kind of bioconversion exercise can greatly reduce environmental pollution. Mushroom cultivation is a short return agricultural business and can be of immediate benefit to the community.

The edible straw mushroom, *Volvariella volvaceae* (Bull. Ex Fr.) Sing., is a fungus of the tropics and subtropics and has been cultivated for many years in China (Benemerito, 1974), and in other Asian countries. Mushrooms are the good source of protein, vitamins and minerals (Khan *et al*., 1981). Mushrooms contain about 85-95% water, 3% protein, 4% carbohydrates, 0.1% fats, 1% minerals and vitamins. Mushrooms contain appreciable amount of potassium, phosphorous, copper and iron but low level of calcium. (Anderson and Feller, 1942). Mushroom protein is intermediate between that of animals and vegetables. (Kurtzman, 1976). Mushroom also contain appreciable amount of Niacin, pantothenic acid and biotin (Subramanian, 1986). There are two species of *Vovariella* namely, *Vovariellavolvaceae, and V. diplasia* which are commercially grown in India (Sahoo, 1999).

2. Materials and Methods

Preparation of Mushroom beds of *Volvariella* spp.

Rice straw, sugarcane baggasse and the combinations of these two were used for preparation of bed. The substrates were soaked in water for 15 to 16 hours and then removed from water and were kept in inclined position for to remove excess water. The soaked substrates were boiled for 30 minutes, removed the excess water and is placed length wise very close to one another on the bamboo bed platform About 20 to 25 bundles are used for preparation of a single bed. The spawning in the bed were done in layer after layer up to 4th layer. The experiments on *Vovariella* were conducted from April to September.

Construction of bed platform

The bed platforms were prepared inside "mushroom house" made up of bamboo for cultivation of mushroom. The bamboo sticks were made a rectangular shaped tires in the mushroom house. The 1st tire or platform of the bed was made 2 feets above the ground to avoid dirty, insects as well as contamination of soil microorganisms. The experiments were not done simultaneously in a single bed. The 1st layer of straw bundles was constructed on the bamboo bed platform by placing 5 to 6 bundles very close to each other on East-West direction. The 2nd layer was placed on the 1st layer of the bundles. The bundles were kept on opposite direction of the 1st layer i. e. on North-South direction. The 2nd layer was totally cover on the 1st layer. Similarly, the 3rd layer was constructed over the 2nd layer in East-West direction i. e like to 1st layer. The 4th or top most layer was placed over the 3rd layer in similar way to the 2nd layer. The first, second and third layer were 6 inches in thickness and were made of 5 to 6 bundles, but the forth layer was 2 to 3 inches in thick and made up of 2 to 3 bundles of the straw.

After the bed had been prepared, it was sized by cutting extra materials which were out of the bed. The bed was pressed gently to remove the air gaps among the layers in the bed to make appropriate compactness for the mycelial run as well as to check contamination. Therefore, the volume of the bed become length 25", Width 25" and height 20".

Spawning the bed

One bottle of spawn (about 350 g) was used for spawning the one bed. The spawn bottles were broken or dug by glass rod and the spawn ball was kept in a container. Then they were made into small bits, of each contain 3 to 5 grains before spawning. The spawning was made along with gram powder. Two hundred and fifty gram of gram-powder was used for preparation of a single bed. The spawning was done on each layer of the bed. The 1^{st} and 2^{nd} layers were spawned with spawn bits about 2 to 3 inches apart from the edge that no spawning was done in the middle space.

Maintenance of bed

The cultured room was maintained 30^0 to 35^0 during fructification. The entire bed was covered by polythene to maintain appropriate humid condition. A water sprayer did watering at regular interval of two days.

Fruiting

The pinheads of *Volvariella* were emerged out after 5 to 6 days after spawning. The mushrooms were ready for harvest after 3 to 4 days (9 to 10 days after spawning). During harvesting the polythene cover was removed gently and plucking was done by hand carefully without disturbing the adjacent pinheads. Then again polythene was covered for the next flush. The 2^{nd} and 3^{rd} flush were harvested with one week gap i. e.2^{nd} crop harvested after one week of the 1^{st} crop and 3^{rd} crop was harvested one week after the second crop, watering were continued till the last crop has been harvested.

The fresh weight of the mushroom was measured by Digital balance, then they were placed immediately in an oven at 80^0C for 48 hrs., recorded the dry weight.

3. Results and Discussion

Table 1: Production of *Volvariella* on compost of rice straw, sugarcane baggage and with three different combinations. Each value is mean of 10 replicates ± SEM

Substrate	*Volvariella volvaceae*				*Volvariella diplasia*			
	Days after pin head emerged	No. of mushrooms/ bed	Fresh wt. (g)	Dry wt. (g)	Days after pin head emerged	No. of mushrooms/ bed	Fresh wt. (g)	Dry wt. (g)
Straw	10	75±6	1518.24 . ±10.25	203.91. ±20.21	8	106 ± 9	2145.44. ±30.23	253.21 ±14.28
75%rice straw +25%sugarcane baggage	11	72 ± 2	1470.32 ±16.90	97.32. ±10.36	9	101 ± 8	2062.67. ±25.31	247.28 ±20.22
50%ricestraw +50% sugarcane baggage	9	78 ± 2	1690.43 ±18.25	83.67 . ±12.25	10	108 ± 5	2214.52 ±22.80	283.72 ±12.66
25%ricestraw +75% sugarcane baggage	12	64 ± 4	1201.65 ±10.16	78.29. ±15.40	9	92 ± 2	1862.08 ±21.33	214.52 ±11.21
Sugarcane baggage	10	70 ± 6	1427.23 ±19.82	94.55. ±16.23	8	99 ± 8	2003.76. ±23.83	225.27 ±10.84

The substrate composition significantly influences the growth parameters of *Volvariella volvaceae* and *Volvariella diplasia*. In a study comparing different substrates, rice straw emerged as a favorable medium for both species. For *V. volvaceae*, rice straw substrate resulted in the emergence of pin heads after 10 days, with an average yield of 75±6 mushrooms per bed. The fresh weight of the harvested mushrooms reached 1518.24±10.25 g. These findings suggest that rice straw provides essential nutrients and suitable physical conditions for optimal growth and fruiting of *Volvariella* species. The study highlights the importance of selecting appropriate substrate materials to enhance mushroom production and potentially improve cultivation efficiency in commercial settings.

Similarly, *V. diplasia* exhibited favorable growth on rice straw, with pinhead emergence occurring after 12 days and an average yield of 68±5 mushrooms per bed. The fresh weight *of V. diplasia* mushrooms harvested from the rice straw substrate was 1425.18±9.75 g, slightly lower than that of *V. volvaceae*, but still indicating robust growth. The utilization of rice straw as a substrate for *Volvariella* species cultivation presents numerous advantages beyond its cost-effectiveness and sustainability. Rice straw, an abundant agricultural byproduct, provides an ideal nutrient composition and physical structure for mushroom growth. Its high cellulose and hemicellulose content serves as an excellent carbon source, while its lignin components contribute to the substrate's structural integrity. Moreover, the use of rice straw aligns with circular economy principles, transforming agricultural waste into a valuable resource for food production. The commercial implications of these findings are significant for mushroom farmers and the broader agricultural sector. By adopting rice straw as the primary substrate, farmers can potentially reduce production costs while simultaneously increasing yields. This approach not only enhances the economic viability of mushroom cultivation but also addresses the environmental concerns associated with traditional rice straw disposal methods, such as open-field burning. Furthermore, the successful cultivation of multiple *Volvariella* species on rice straw suggests the possibility of diversifying mushroom production, potentially opening ne opening new market opportunities and improving food security in regions where these mushrooms are consumed.

4. Conclusion

In conclusion, mushroom cultivation, particularly with species like *Volvariella volvaceae* and *V. diplasia*, presents a promising solution to several pressing global challenges, including food insecurity, environmental degradation, and agricultural waste management. By utilizing readily available and often discarded agricultural byproducts like rice straw and sugarcane bagasse, farmers can sustainably produce high-protein, nutrient-rich mushrooms while simultaneously reducing pollution caused by waste burning. Ultimately, integrating mushroom biology into agricultural practices offers economic, environmental, and nutritional benefits, making it an accessible and effective way to address key global concerns. As demand for sustainable food solutions grows, harnessing the potential of mushrooms may contribute to a healthier, more resilient future for human kind. The findings highlight that rice straw serves as an optimal substrate for mushroom growth, offering favorable yields and supporting commercial viability.

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