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Impact of various substrates for enhancement and mass production of paddy straw mushroom

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Abstract
In the modern world, disposing of agriculture waste is a major concern because they are nutrient-rich and their disposal without pre-treatment might result in leaching in the ground, which can lead to the environmental damage. The most environmental friendly way to solve this issue is to grow mushrooms on these agricultural wastes, which will lower the level of nutrient to an acceptable range for use as bio-fertilizers. A well-defined combination of agricultural wastes also produces a large output of mushroom in an economical way in addition to solving this way. Make sure that we are using the right substrate so we can effectively grow mushroom. We'll be aware of what a mushroom substrate is and its purpose. We will be familiar with several typical mushroom substrate types and the preferable mushroom substrate. A substance that allows the growth and establishment of mushroom mycelium is known a substrate. The substrate supplies the nutrients, moisture and energy necessary for mushroom to grow and produce fruit. Paddy Chinese mushroom is a healthy food choice thanks to its outstanding composition of various ingredients and necessary amino acids as well as its reasonable amount of super molecules, crude fibres, and ash. A large portion of India's states offer a great deal of potential for the commercial production of *Volvariella volvacea* due to the readily available paddy straw and suitable environmental conditions. The mushroom will just be cultivated by the agricultural girls, who will benefit financially from it as well as be able to meet their daily needs for super molecules.

Keywords: *Volvariella volvacea*, substrates, agriculture waste, cultivation

Introduction
Volvariella volvacea, well known as straw mushroom. It is a member of the *Volvariella* genus in the Basidiomycota subclass Basidiomycetes, order Agaricales and family Plutaceae (Singer, 1961). It ranks third in the terms of importance for grown mushroom and is renowned for its pleasant flavour and its taste. A substrate gives mushrooms the nutrients, moisture and energy they need to grow and produce fruits. It is a medium where mushroom mycelium can grow and establish itself. The majority of them are burned and disposed of in this way, which is polluting. Growing mushroom on agriculture waste satisfies ours demand. Mushrooms are fleshy funguses that grow above the ground soil and producing fruiting bodies that contain spores. They cannot produce food on their own since they lack of chlorophyll like green plant. They are products that can be made from lingo-cellulosic waste that are incredibly nutrient wastes it to bio-convert them into products with value added. Various edible mushroom strains are cultivated worldwide. In addition to being rich in nutrient, they are helpful in waste control. Which species to grow that, will depend with in growing media that is available. Due to their short shelf lives, these species are particularly advantageous to local growers who can market directly and consistently provide a high-quality & fresh product. Market gardens can benefit from mushroom cultivation if it is incorporated into the current production system. In addition to being rich in nutrients, they are helpful in waste controlled. Mushroom are a great source of many nutrient, including protein, which ranges from 18% to 37% of the dry weight.80 to 90 percentage of a mushroom by 3 percentage protein and 4 percentage of carbs, 0.1 percentage of lipids, 1 percentage of minerals and a little amount of vitamins (Tripathy, 2010; Bolton and Blair 1982) [31, 6] Minerals and vitamins-mushroom are good source of Ascorbic acid and vitamin K, vitamin D, vitamin A, vitamin D3. hey also include sizeable levels of zinc, iron, calcium, magnesium, sodiumans salt. Many mushroom increase body immunity. Those with HIV/AIDS will find this to be a relief. The gastrointestinal tract's physiological processes depend on its fibre content (Manzi *et al*. 2001) [19]. The mushroom substrate needs to be properly treated which include adding water, perhaps more nutrition, and sterilising. When ready, it can be "inoculated," which involves uniformly distributing broken-

up bits of mycelium-covered grain (sometimes referred to as grain spawn) into the substrate. When the correct circumstances are present, the mycelium will begin to grow and will quickly consume and decompose the organic matter, a process known as "colonisation." Once the substrate has been entirely colonised, or when the mycelium has completely solidified and encircled it, the mycelium of mushrooms are prepared to fruit. About 700 million tonnes of agricultural by product are produced in India each year, and they can be used effectively to grow mushroom. India contributes less than one percentage of the total global mushroom cultivation. Our ability to produce 7.0 million tonnes of fresh mushrooms will match current global mushroom production (Anonymous, 2011) [1]. To increase the productivity of this mushroom, a variety of agricultural wastes can be employed in its cultivation, along with a variety of supplements. According to Walting (1994) [33], very little contemporary research on this fungus (mushroom) has been conducted by Indian researchers. As a result, considerable efforts must be made to address the issues relating to the cultivation of *Volvariella* spp. Paddy straw growing mushroom doesn't require extra farmland or financial investment. It can be successfully grown indoors and outdoors on different agricultural wastes in natural environment situation, with the maximum range temperature (29-40°C), coupling with high relative humidity 70 to 80 percentage triggers the process. It also has a shorter growing life-period.

According to Ishara *et al*. 2018 [13], Feeney *et al*. 2014 [11] and Castro-Rios, 2017 [8] and other researchers mushroom are a significant food to address difficulties with human health, food and nutrition security, and climate change adaptation (Gellerman 2018; Langston 2014) [12, 16]. One edible mushroom species grown across East and Southeast Asia is the rice straw mushroom (Sudhu *et al*. 2008) [25].

It also has therapeutic ingredients. Therefore, mushrooms add to a cuisine that is suitable for people with diabetes, heart disease, high blood pressure, and cancer (Ahalwat and Tewari, 2007) [2]. Production and consumption of mushrooms have greatly expanded in various nations due to their numerous advantages and benefits (Bernas et al. 2006 and Vizhanyo and Jozsef 2000) [5, 32]. The Rice straw mushrooms are abundant in healthy fats, dietary fibre, minerals, and vitamins. They also include high quality proteins (Chang and miles, 2004, Roy and Chakraborty, 2018) [9, 23].

Optimum Conditions for Mushroom Cultivation

During cultivation, the environment should also be kept in its ideal conditions. The typical ideal conditions that are to be kept during mushroom cultivation are listed below:

Temperatures should be between 15 to 36 °C, pH of around 6.5, CO_2 levels between 15% to 20%, It have a humidity of 86% to 90%, CO_2 levels should range from 0% to 0.6%

Different substrates on the *V. volvacea*

Similar to how dirt is used to produce (growing) plants, substrate is used to cultivate mushrooms. It is where the mushrooms will obtain all of nutrient while they are developing. Just as plants need soil with particular qualities, various forms of mushrooms prefer particular sas a substrate. Mushrooms can grow and produce fruit because the substrate gives them to the nutrition, moisture, and energy they need. Fibrous substances like lignin, cellulose and hemicellulose are abundant in a suitable substrate. (These are rich in carbon, which is ours mycelium's primary food suppliers.) Here are some factors to think about while selecting a substrate. 4 substrates, mainly, rice-straw and pea-straw, wheat-straw & cotton waste, were assessed for improved yield (To find the best common substrate for paddy straw mushroom) of the using paddy straw mushroom to ascertain the optimal substrates for its production in Eastern UP. The culture technique employed in this experiment was slightly modified from that described by Thakur *et al.* 2003 [29].

Preparation of Substrates

Fresh harvested paddy straw or other substrates (such as pea, wheat, or cotton straw) were formed into bundles measuring 15 to 25 cm in diameter and 45 to 50 cm in length. For the purpose of making a bed, 14 of these bundles were used. These bundles were soaked in a watertank with 100 litres of water, 20 mililiitres of formalin, 5 grammes of bavistin, and 500 grammes of calcium carbonate. A polythene sheet was used to cover the water tank, and it was left that way for the one night. After being wet, the straw was taken out of the tank and placed on a spotless concrete floor to drain any extra water.

Fig 1: Different step of preparation of paddy straw substrates

Care after spawning

All other substrates, including that four wet bundles of paddy straw, were used in a single layer on an elevated structure. The first layer of straw was surrounded by a line of spawn grain that were pushed within at a distance of around 4-5 cm from with the outside margins. Chickpea flour was lightly strewn around the surface of the spawned because of, they can't produce nutrients through photosynthesis, they must

instead obtain them for their environment (Palitha Rajapakse, 2011) [24]. By retaining the straw bundles in the exact opposite of the first layer's direction or and arranging them in a intersect pattern, the second layer of straw bundles were created. The chickpea powder was sown and dusted as before. The third layer's straw was positioned in the opposite way from the second layer. Chickpea powder was produced and dusted through the third layer's surface. The straw bundles were carefully positioned in the fourth layer corresponding to the orientation of the second layer. It was not necessary to spawn in this layer because it was the covering layer. 85g of *Volvariella volvacea* spawn, 30 g of chick-pea powder, and 14 bundles paddy straw were used to prepare the one bed. In order to allow for an efficient spawn run, entire beds were now compressed and then covered with a clear polythene covering.

Table 1: Change in substrate has an impact on paddy straw mushroom production yield:

Sl. No.	Substrates	Cropping period	Spawn running (days)	Pinhead formation (dps)*	Initial Harvest (dps)*
1	Paddy straw	I II	6 7	10 10	12 13
2	Pea straw	I II	6 7	11 11	13 13
3	Cotton waste	I II	8 10	12 12	14 15
4	Wheat straw	I II	8 9	12 13	16 17

*DPS: Days Post Spawning

Fig 2: Different substrate on yield in Paddy Straw Mushroom

This table discusses the various substrate and number of days needed for spawning, each cropping phase, the first harvest and pin head formation were noted. According to Table 1, the time required for spawn run in various substrates ranges from 6 to 10 days, the time required for pin head development is between 10 to 13 days, and the time required for the first harvest is between 12 to 17 days. Paddy & pea straw substrate required at least 6 to 7 days for spawning, where as wheat straw and cotton waste required at most 8 to 10 days for both cropping seasons.

Paddy and wheat straw substrates result in early pin head development 10 to 12 Days Post Spawning and a 16 to 17 days post spawning, first harvest. For the production of pin head development and the first harvest, cotton waste takes 14 and 15 days, where as wheat straw takes 13 and 16 days.

Paddy straw and cotton waste substrate produced the most fruiting bodies per bed, followed by pea and wheat straw.

In these cases cotton waste and paddy straw substrate also produce significantly highest yield both the cropping period.

The research of Sindhu *et al*. 2001-2002 [26] and Jiskani *et al*. 2004 [14] confirm this conclusion. In their trails, the substrates made from cotton waste and paddy straw produced the most flushes and production. Singh and Singh (2012) [27] discovered that wheat straw was superior than paddy straw as a substrate.

Table 2: Various supplement on Paddy Straw substrate for the yield of *V. volvacea.*

Sl. No.	Supplement	Spawn running (days)	Pinhead development (days)	Initial Harvest (days)	Weight of mushroom / bed (g)
1	Rice bran	6	8	12	821
2	Wheat bran	7	8	12	792
3	Chick pea grain powder	6	8	13	745
4	Pea grain powder	7	9	14	690
5	Pigeon pea grain powder	7	9	14	710

Effect of various supplements on the *V. volvacea* yield

Five supplements, including rice bran, wheat bran, chickpea powder, pea powder and pigeon pea powder, were assessed to able to increase the paddy straw mushroom production. Separate amounts of each dietary supplement were applied to the spawn surface of each, paddy straw substrate for the bed using 25 g of grain powder.

This table discusses the five supplements that were tested on paddy straw. The maximum yield was obtained from the substrate using rice bran (821 g / bed), next wheat bran (792 g / bed), chick-pea powder (745 g / bed), pigeon-pea powder (710 g / bed) and pea powder (690 g / bed). The studies of Tripathy *et al*. 2011 [30], Kaur *et al*. 2004 [15], and Bahukhandi *et al*. 1989 [4], who reported that yield of 2 percentage of rice /wheat bran enhanced Volvariella volvacea based on the paddy straw's dry weight. According to Matiru *et al*. 1992 [18], Rice-bran & corn-meal and *Leucaena leucocephala* (ipil-ipil.) meal, chicken dung, coconut sawdust were included increased the microbial growth.

We came to the conclusion that, paddy straw mushroom culture should be carried out on cotton waste, pea straw, or paddy straw substrate based on distinct substrate and supplements. Since cotton waste is not readily available in eastern Odisha, it is best to cultivate cotton on a pea or pea or paddy straw substrate, which must also be supplements with addition to rice bran or chick pea grain powder to enhance the yield of this mushroom.

Table 3: Effect of spawn derived from wheat grain addition with various combination of lignocellulose waste on *Volvariella volvacea* fructification:

Sl no.	Spawning substrate/ yield	Days required for pin head formation	Standard no of mushroom	Yirld / bed (g)
1	Wheat percentage	5	79	1291
2	50 percentage Wheat + 50 percentage Rice bran	6	90	1359
3	50 percentage Wheat + 50 percentage Wheat bran	7	57	800
4	50 percentage Wheat + 50 percentage Straw	7	65	805
5	50 percentage Wheat + 50 percentage Sawdust	9	70	870
6	50 percentage Wheat + 50 percentage Sugarcane bagasse	7	40	960

The cumulative impact wheat grain combined with various Effect of lignocellulose waste substrates on *Volvariella volvacea* yield was Table 3 illustrates the pin head development in spawn, wheat and saw dust was followed by wheat and wheat bran, wheat and straw, wheat and sugarcane baggage were the next combinations (7 days). In the case of wheat, pin head development only required 5 days. Other substrate, however demonstration complete pin head development in 5 to 6 days.

We can use a variety of materials as a substrate while growing mushroom. Some are relatively traditional, while others are little more cutting-edge and experimental. Here are a few of the substrates that mushroom growers currently use most frequently.

Coffee grounds

It's also one of the simplest to grow in coffee grounds. Just mix 100 grammes of mushroom spawn with 1 kg of coffee grounds. For improved air exchange and a quicker rate of colonisation, you can additionally add 20% straw to your mixture.

Fig 3: Ready to use coffee grounds

Coco Coir and Vermiculite

A substance called coco coir is created by grinding up coconut husks and shells. The majority of garden retailers sell it. Yellowish-brown mineral called vermiculite is commonly accessible in garden centres all over the world and is used to retain moisture. Some species of mushrooms can be grown in the perfect substrate made by combining these two substances.

Manure

Manure is obviously not the best growing medium in our opinion. Regularly handling and boiling up animal waste is not something you want to do. However, it's essential for other varieties, such as common button mushrooms. For mushrooms, we can use manure from horses, chickens, cows, or other animals. Typically, two parts manure and one part coco coir are called for in recipes. After that, the entire combination must be disinfected before being inoculated with mushroom spawn.

Logs

Even solid wood might be regarded as a substrate! Shiitake and other kinds of mushrooms are frequently grown outdoors on logs.

The majority of hardwood tree species, including beech, poplar, maple, oak, birch, and more, can be used.

Logs that are three to four feet long and four to six inches in diameter work best for growing mushrooms. You shouldn't utilise wood that has been dead or dying for a while. It's possible that several fungi have already started to colonise the wood, which can make it more difficult for your preferred mycelium to grow.

Hardwood Pellets

For a variety of mushrooms, hardwoods like maple, oak, or beech create an excellent substrate. Just stay away from using pellets or sawdust from softwood trees. You'll need 2.8 litres of water and 10 cups of hardwood pellets to build a block of substrate weighing 10 pounds. Since sawdust is transformed into wood pellets during the manufacturing process, they don't need to be sterilised. The majority of growers add bran to their hardwood sawdust. Some varieties of mushrooms might not be able to grow on wood alone due to a lack of nutrients.

The paddy straw mushroom is grown on a variety of substrates (*Volvariella* spp.) Banana leaves, wheat bran, sugarcane baggages, rice straw, and rice bran are a few of these agricultural wastes. The leftovers from mushroom production are typically fed to animals as feed. The wastes contain the most nutrients and can be more easily digested as a result of the mushroom creation (Chandra and Chaubey, 2017) [10]. Numerous organic matter-rich substrates have been used for mushroom growing. Paddy straw, wheat straw, and dried banana leaves and Peeled cassava waste from the cassava oil mill, coconut fruit fibre from the Coconut farm, and oil cake from the oil Mills have been employed as vegetable waste as the substrate for mushroom cultivation (J.W. Zakhary *et al*. 1984) [34].

Conclusion

India, the next biggest vegetables producer in the globe, provides 14 percentages to global vegetable production. Considering the 150 million tonnes of fruit and vegetable produced in India. Wastes from fruit and vegetables are more likely to spoil than cereals wastes due to the chemical configuration, which leads to the impure condition that can spread disease and depleted resources. Although the vegetables wastes are high in nitrogen and carbohydrates,

they should not edible for human. The cultivation of many forms of mushroom, including the oyster variety, can be done with the help of these vegetable wastes.

Cost-effective farming is made possible by the agricultural waste. Even after being employed to produce mushroom, it can still be utilised latter as manure for an agricultural area because the high nutrient levels are now within permissible limits. One of the most environmentally beneficial methods to combat environmental degradation and malnutrition caused by these wastes is to cultivated mushrooms on these leftover wastes.

Our success depends on making the proper substrate selection and substrate preparation for the particular species of mushroom we are growing. Some species, such as oyster mushroom, can grow thrive on variety of materials, such as paddy straw or even cardboard. Some species, however, are pickier and will only generate large harvest when cultivated on a particular substrate.

What substrate is ideal for ours ultimately depends upon the region & growing method, and the kind of mushroom. The best approach to learn is to experiment with various substrate kinds, preparation techniques, and supplementation strategies.

According to the study, there was a strong relationship between the quantity of fruiting bodies and the production of fresh paddy straw mushroom and the varied substrates. His combination of the 50% rice bran, 50% wheat straw, and 50% paddy straw produce the most fruiting bodies and fresh weight (table- 3). he combination of producing spawn from wheat and rice bran showed the maximum mycelial development. The most abundant yield of *V. volvaceae* (1360 g), due to the better growth and spawn output, the usage of the wheat bran combined addition with the rice bran seems to be the most appropriate. It is advised to used rice straw as the substrate for a mushroom bed because it is the low cost quality that is available in tropical areas.

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