



E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(5): 330-334
Received: 01-07-2019
Accepted: 03-08-2019

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Study on mushroom uses, preparation, nutrition, cultivation and its growth characters

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Abstract

Mushroom is a 100% vegetarian diet having tremendous medicinal properties. They are rich in protein, fiber, and amino acids. It is also good for joint pains, lowers cholesterol and helps in purifying blood with substantial vitamins and minerals. From mushroom pappads, soup powder pickles, health powder, health drinks, pakodas and capsule can be prepared. Oyster mushroom (*Pleurotus ostreatus*) was cultivated on wheat straw basal substrate cotton seed hull basal substrate, rice straw basal substrate, and wheat straw or rice straw supplemented with various proportions of cotton seed hull. The effect of autoclaved sterilized and non-sterilized substrate on yield and yield contributing factors of oyster mushroom was also studied. Obtained results specified that sterilized substrate and non-sterilized substrate, oyster mushroom on wheat basal substrate and rice straw have exhibited faster mycelial growth, moderately poor surface mycelial mass, and days from bag opening to primordia formation, and lower production with lower mushroom weight.

Keywords: Mushroom, oyster, button, nutrition, preparations, properties

Introduction

It is assessed that the number of mushrooms on earth is 40,000 (approximately) but only few 10% are known to mankind (Hawksworth, 2001) [1]. As commercial cultivation improves, and global markets expand, the variety of readily accessible mushrooms has increased substantially. Mushroom cultivation can be a hobby with delicious results that could easily become a profitable small business, due to the low cost of inputs and high value of the crop. Contamination happens during the colonization of spawn jars but can also happen with bulk substrates if they are not prepared correctly. Different Mushroom species is used to control various ailments as shown in table 1. At present, the total mushroom production in India is approximately 0.13 MT. It has registered an average growth rate of 4.3% per annum (2010-2017). Out of the total production, white button mushroom share is 73% followed by oyster (16%), paddy straw (7%) and milky mushroom (3%). Compared to other vegetables; per capita consumption of mushrooms in India is meagre and data indicates it is less than 100 grams per year. Indian mushroom industry generated revenue of Rs.7282.26 lacs by exporting 1054 quintals of white button mushroom (2017-18). This food is low in sodium, and very low in saturated fat and cholesterol. It is also a good source of protein, thiamin, vitamin B6, Folate, Iron, magnesium, and a very good source of Dietary Fiber, Riboflavin, Niacin, Pantothenic Acid, Phosphorus, potassium and Copper.

Human body may synthesize various substances (required) like glycolipids, polyketides, sesterterpenes, aromatic phenols, derivatives of fatty acid and shikimic acid polyacetylamine, along with nucleosides, but these substances are not significant quantity hence, outside supply through various dietary supplements etc. is required. Their sources can be different (Lorenzen and Anke, 1998; Wasser and Weis, 1999; Mizuno, 1999) [2, 3, 13]. Mushrooms may supply all these nutrients as edible mushrooms are supposed to be safe having no objectionable side effects. From ancient times mushrooms are considered as a part of human food. But due to its polysaccharides chemists and immunobiologists have concentrated their focus towards its use (Borchers *et al.*, 1999; Wasser and Weis, 1999; Leung *et al.*, 1997) [4, 3, 13]. Various health promoting characteristics such as anticancer, antimicrobial, cholesterol depressing, antioxidant along with immunostimulatory influences have been described for mushrooms (Anderson, 1992; Mizuno, 1999; Mau *et al.*, 2004) [6, 13, 14].

Mushrooms are frequently used as vegetable but for controlling specific disease, it should be consumed in following way

In case of Diabetes

One cup (normal) of meshed portabella mushrooms species and add one cup of panfried shiitake mushrooms. Both kinds deliver 3 grams (about) of fiber.

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Such fiber content beneficial for digestive system and decreases the risk of heart ailment and metabolic disorder/disease. In developing countries like USA 21-25

grams per day of fiber for females and 30-38 grams/day for males is recommend.

Table 1: Different Mushroom species is used to control various ailments

Name of mushroom species	Used to control
<i>Pleurotus tuberrigium</i>	For treatment of headache, fever, cold and stomach aching and constipation
<i>Lentinus squarulosus</i>	For treatment of mumps and several heart diseases
<i>Termitomyces microcarpus</i>	For treatment of gonorrhoea ailment
<i>Calvatia cyathiformis</i>	For treatment of hiccups, sterility and leukorrhoea
<i>Ganoderma lucidum</i>	For treatment of neoplasia and arthritis (stiffness)
<i>Ganoderma resinaceum</i>	As hepato-protector and controlling blood sugar disorder
<i>Ganoderma applanatum</i>	Having Antioxidant properties, antihypertension and hypoglycemic
<i>Schizophyllum commune</i>	For treatment of diabetes disorder
<i>Volvariella volvaceae</i>	Having Antineoplastic and Antibiotic properties
<i>Auricularia auricular</i>	For control of hemoptysis and hemorrhoids diseases
<i>Daldinia concentrica</i>	For treatment of whooping cough, various skin diseases, stomach upset and its ulcer and inhibition of unnecessary fetus growth to facilitate informal delivery.
<i>Polyporus officinalis</i>	For treatment of hernia eye disorder treatment and cough

Source: Akpaja *et al.* (2003)^[8]; Ayodele *et al.* (2009)^[9]

For heart health

Sodium (Na) and Potassium (K) work collectively in our body to regulate B.P. Ingesting mushrooms helps to lessen blood pressure and decline the risk of high B.P along with cardiovascular ailments. Moreover, consumption of 3 grams (roughly) of beta-glucans/day helps to reduce blood cholesterol by 5 percent (approximately). Beta-glucans can be obtained from Shiitake mushroom stem which is principally a good source for the same.

For Immunity sake

Selenium element improves immunity response to different kinds of contamination by exciting the production of destroyer T-cells. Mushrooms may excite the immune system of the body to fight against cancerous cells and avoid tumors formation as beta-glucan (active ingredient) is found in the cell walls of mushroom. Recently it has been discovered that beta-glucans might advance insulin resistance along with blood cholesterol levels, depressing the risk of fatness and offering an immunity improvement.

For Weight management

Obesity is the main problem of our modern life style. In this situation dietary fiber plays vital role in weight managing by acting as a "bulking agent" in the digestive organization of the body. In cell walls of mushrooms two kinds of fiber chemicals named- beta-glucans and chitin are present. They are responsible for satisfying hunger needs and lessen hunger. In other words, they can cut total calorie consumption.

Selection and storage of mushrooms for consumption

While procuring mushrooms, always chose ones that are steady, dehydrated, and without any injury. Evade that give smarmy or shrunken appearance. If need store them in the refrigerator and never wash or slim/trim them until ready for use.

Some Mushroom Preparations

Decoction

The modest method of Preparations of this polypore is as decoction/tea. Hot water treatment is required for break down the hard, woody material etc. of these tree mushrooms to make the medicinal ingredients available to human beings. Use two handfuls of mushroom per liter of water

(approximately). Boil and simmer this blend for at least 25-30 minutes, up to some hours. Bulky quantities can be prepared like this way and kept in the fridge to be consumed as needed. It can be mixed with other herbs also like ginger etc.

Soup Broth

Indigenous people of West Coast consume Reishi Mushroom by simmering method. By this technique obtain a healing and healthful broth for soups etc. But any medicinal mushroom may be consumed in this way. Reishi Mushroom boosts the immune system very incredibly.

Tincture

Alcoholic tinctures from mushrooms are very influential in drawing the medicinal valued contents out of the hard mushrooms and ensure their availability. It is done in the following manner-

- Take a jar and Fill it 2/3rds with mushroom material.
- Rest jar should be filled with an alcohol (40%).
- Shake it occasionally and wait for 2-3 weeks.
- Strain and Decoct the solution. Mix 1 part of this tea with 1 part of the alcohol so that alcohol content should be minimum 20%. It can be bottled. Depending on individual taste it can be mixed with in any recipe.

Extract Powder

Mushroom cultivation through modern techniques makes it possible to munch highest quality and pure extracts of mushrooms. Such extract powder can be added to smoothies, to savoury dishes and to chocolate. It is highly effective and easy to use.

Mushroom Chocolate

- Take 2 parts of cacao paste along with 1-part cacao butter.
- Also add sweetener or 1-part Maple Syrup according to your taste.
- Add 2-3 tablespoons of mushroom /powder per serving.
- For synergistic flavor 1 tablespoon of ginger powder can be added. It increases the delivery of the medicines through the body.

Nutritional profile of mushrooms

Mushrooms are obviously low in sodium salt, fat free along with zero calories and cholesterol. They are also known as

"functional foods." Besides providing elementary nutrition, they also prevent chronic ailments as they contain antioxidants and dietary fibers e.g. chitin and beta-glucans.

Generally, one cup of white mushrooms comprises 15-20 calories, 0% fat, 2.2 gm of protein, 2.3 gm of Starch/Carbohydrate, including 1.4 gm of sugar content and 0.7 gm of fiber.

Normally all mushrooms offer same amount of nutrients irrespective of size or shape.

Vitamins and minerals

All mushrooms are rich in vitamin B (riboflavin, niacin, thiamine, folate and pantothenic acid). Via vitamins B body gets dynamism from food and they also assist the body in formation of RBC. B vitamins is supposed very significant for powerful brain. Pregnant ladies are also directed to take folate or folic acid during pregnancy. Mushrooms are considered as veggie, non-fortified nutritional Vitamin D source. Animal meat is good source of vitamin D, but vegetarians do not consume any meat products, so mushrooms are very good alternative for them being important source of vitamin B. There are some other minerals that are very rare or trace in vegetarian diet such as phosphorus, copper, iron, potassium and selenium but they can obtain from mushrooms a lot. They also contain choline. It is very vital element that helps with muscle movement, sleep, memory and learning. Choline contributes in sustaining the cellular membranes, supports the transmission of nerve cells by impulses, supports appropriate fat digestion and lessens chronic swelling.

The major problem to the utilization of edible and medicinally (mushrooms) is their being periodic nature. Cultivation of mushroom is both science and an art. It is complex business and necessitates exactness (Chang, 2008). Hence, modern technology for cultivation mushrooms needs to be made simple and commonly accessible. Practical stages in cultivation of mushrooms such as selection of a suitable mushroom cultivar, excretion of a good-quality fruiting culture, growth of healthy spawn, preparation of discriminating compost, care of mycelia consecutively, management of fruiting and mushroom development and cautious harvesting process for mushrooms listed by Chang and Chiu (1992) and Chang (1998) have to be consistently trailed.

The second main problem is distinguishing edible species from poisonous one. Both morphological and molecular

identification measures can be used to resolve such hurdle. Some morphological features may be enlightened that laymen can differentiate edible species from non-edible/poisonous mushrooms species.

Methodology Adopted for Button Mushroom Cultivation:

Wheat straw is spread on a 'pucca' floor and wetted thoroughly with clean water. This is done gradually by continuous mixing with the help of pitchforks until its moisture content is 70-75%. The wet straw is then kept as such for 48 hrs. Side by side, wheat husk powder is mixed with fertilizers (CAN, Urea, Superphosphate and MOP) and moistened with water. This mixture is made into a heap and kept covered with gunny bags for a day. The bran-fertilizer mixture is then broadcasted on the wet wheat straw and mixed using pitchforks. The loss of nutrients due to leaching must be avoided and the run-off water, if any, should be mixed back in the straw. Thereafter, a stack of 5x5x5 inch is prepared with the help of 3 wooden boards keeping the width and the height of the stack unchanged, the length can be increased depending upon the quantity of straw taken. The boards should be removed from the sides of stack as soon as it is ready. To get a homogenous compost, a proper shape and size of the stack is utmost importance. The compost prepared from 300kg of straw weighs approximately 570-580 kg at 67-70% moisture content and is sufficient to lay about 12s.q.m. bed area, using 50 kg compost per Sq. m. In other words 60 empty fruit crates (7-8 inches deep) or bags (24x16 inches) will be required for this quantity of compost.

Turning of compost

The temperature of the stack rises to 68-75 °C in the inner layers within 48 hrs after stacking. The microbial activity during decomposition is maximum in these hot layers as long as oxygen is available. To achieve this, turning of the stack are exchanged with the inner portions. In all, 7 turnings are given to get a final grade compost.

At each turning, 10-12-inch layer of the stack is removed from all the sides and the top and is thoroughly mixed and wetted if need be. The remaining stack is broken open, its contents are mixed well, and water is added, if required. It is necessary to have a moisture level of about 70% at the time of each turning. A dry or too wet compost is liable to be of inferior quality. The pile is then re-made in such a way that the original outer portion goes inside the new stack.

Following this principle, a schedule of 7 turnings is followed as given below

Turning No	Day	Activity
First turning	4 th day	5kg of molasses are added in the form of its solution in 20 lit of water.
Second turning	8 th day.	Nil
Third turning	12 th day	30 kg gypsum is mixed by sprinkling the powder on dismantled stack and mixing it before restacking.
Fourth turning	15 th day.	Nil
Fifth turning	18 th day	150g Furadan is mixed dry.
Sixth turning	21 st day	Nil
Seventh turning	24 th day	60ml gamma BHC or Lindane is added in the form of its solution in 15lit water.
Just Wait		Ready to use on 26 th day.

Next to this the spawn is mixed thoroughly in the compost and bagging should be done.

Casing

The practice of covering uniformly the spawn impregnated compost surface with a suitable soil mixture is called casing, which ought to remain moisture and support the growing

pinheads and help them to become button at a quick rate of growth. The prerequisites for an ideal casing soil are:

1. It should have neither big lumps nor should be very fine and powdery.
2. It should possess good water holding capacity.
3. It should be porous enough to allow free gaseous exchange.

- It should not harbor any pest or pathogen. For that purpose, it should be disinfected with steam or suitable chemicals before use.
- Its pH should be 7 to 8.5

Materials for casing soil and disinfection

The materials used for casing are Farmyard manure (1-year-old): garden soil (4:1): FYM (1:1). The contents have been mixed properly and wetted to their water holding capacities before sterilization. The sterilization can be done either with steam or chemicals. For steam the casing soil was treated with a jet of pressure steam in a closed chamber and heated at 61-62c for 6 hours. For chemical sterilization we used 4% solution of formaldehyde. For 2 quintals of casing soil, 1.25 lit of formalin is diluted 10 times and the solution is mixed in the casing soil. The treated soil is heaped and covered with a tarpaulin sheet for at least 48 hours. Thereafter it is opened and turned again for the next 2-3 days to free it from fumes of formaldehyde. It was used immediately after completion.

Procedure

The bags show initiation of spawn run after 2-3 days of spawning. It takes about 2 weeks for the trays to show 80-100% coverage with white mycelium growth. At this stage the newspaper sheets are removed, and spawn-run surface of compost is covered with 1.25 to 1.5 inches thick uniform layer casing soil. Thereafter the water is sprayed once or twice a day.

Materials required for Oyster Mushrooms (Dhingri)

S No	Particular	Quantity
1.	Chopped wheat straw (2-3 inch)	40 kg
2.	Formaldehyde	100ml
3.	Bavistin	12gm
4.	MgSo4	10gm
5.	CaSo4	10gm
6.	Spawn	3kg

Methodology adopted for oyster mushroom cultivation

Preparation of the substrate

Chopped wheat straw is filled in the tub and is wetted thoroughly for 16-20 hours with clean water. The straw attains 70-75% moisture level. Thereafter its excess water is removed by crushing hard with hands and dried under the sun for removal of excess water.

Filling and Spawning

Polythene bags can be used as containers and filled the straw accordingly. Wheat grain-based spawn is used @ 10% of dry weight of straw, the spawn is mixed thoroughly and made heaps to fill the bags. After spawning the upper end of the bag is tied with gunny thread and the bag is pinned or punched with very mild wholes to drain the excess amount of water and gaseous exchange.

Watering

No watering is required for Oyster Mushrooms till the bags are opened after spreading of mycelium in the bags. When the bags are cut open at the appearance of fruiting bodies, light watering is given timely to keep them moist.

In case of White Button Mushrooms regular spraying of water on the spawned and cased bags, it is to be done once or twice a day so as to keep the surface moist. During heavy flushes of crop, the watering is increased by 20-40% depending upon the intensity of crop.

Harvesting

a) Harvesting of White Button Mushroom

The harvesting in White Button Mushroom was done on 2nd week of March. The harvesting is done when the top of the button is not opened, and the button reached about 3-4cm. The mushroom is turned in clockwise or anticlockwise direction in-order to separate from the stack.

b) Harvesting of Oyster Mushrooms

The harvesting in Oyster Mushrooms is done on 2nd week of April. The harvesting is done when the oysters starts turning to wrinkle. The mushroom is turned in clockwise or anticlockwise direction in-order to separate from the stack.

As per the data collected and presented in the Fig.-1 and Fig-2, it shows that mycelium was recorded earlier in the T₃ (10) of Pink Oyster and T₃ (17) of Sajor Caju and T₁ (12) of Pink Oyster and T₁ (19) of Sajor Caju whereas followed by T₂ and T₄ of two varieties. The present investigation on varietal characters and autoclave + chemical treatment reveals that Pink Oyster and Sajor Caju shows early mycelium growth than the treatments and Wheat straw and autoclave + chemical sterilization of the straw helped the T₃ to grow better than other treatments. The graphical representation of the data obtained are as follows

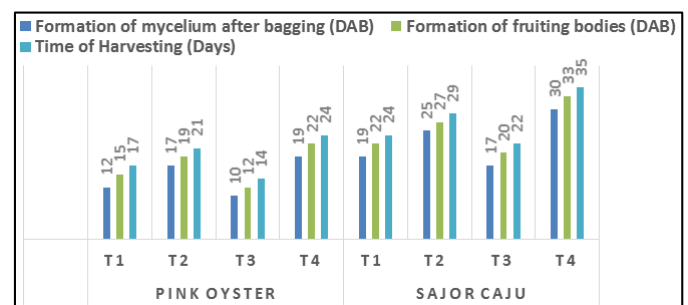


Fig 1: Different growing characters

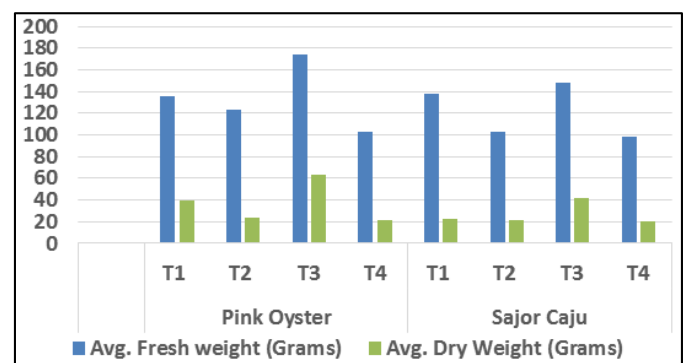


Fig 2: Average Weight

Conclusion

The present work shows that maximum fruiting bodies and minimum days taken for bump formation were observed in Treatment T₃ of Sajor caju and pink oyster which is cultivated and treated as per the treatment (Autoclave+MgSO₄). The white button mushroom, gilled mushroom, pink oyster and Sajor caju were found to give better results on the basis of their yield, number of fruiting bodies and average yield per treatment. It is further determined that temperature, humidity and dark facility if provided based on the particular species, gives the best outputs and higher yield if cultivated on time. It can also have concluded that pink oyster and Sajor caju mushrooms performs better in terms of its growth and yield in sub-tropical

conditions of Punjab during summer seasons. In addition to it, they may supply various vital nutrients safely having no side effects. But some primary research regarding cultural practices needs to be carry out at research level.

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