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Multiple Utilities of Mushrooms

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ABSTRACT

Now a days mushrooms are cultivated for various purposes; they have several applications in industries. Some mushrooms are the best sources of high-quality food rich in protein, vitamins and minerals like yeasts, bacteria and algae. Cultivation of edible mushrooms is an attractive method for accomplishing the task of reuse of lignocellulosic waste derived from agriculture forest and industry, beside its capabilities to detoxify several environmental pollutants. In Addison, many of the genera of edible mushrooms possess medicinal properties. These activities of edible mushrooms could be used in biotechnology methods.

Keywords: Edible mushrooms, biotechnology, food.

INTRODUCTION

Mushroom production is regarded as the second most important commercial microbial technology, next only to yeasts. They mostly belonging to higher Basidiomycotina, which have distinctive fruiting bodies. Out of 69,000 species of fungi, 10,000 species are Mushrooms. Among these fungi more than 2000 species are reported to be edible (Chang and Miles. 1982). The fruiting body of these edible mushrooms may be of different shapes, sizes colours, texture and flavours. Since ages Mankind has sevoured the desirable dishes of mushrooms and has realized their nutritional as well as medicinal properties (Pai *et al.,* 1990). The scientific discoveries have axhibited that mushrooms are biochemically endowed with the ability to secrete a variety of enzymes (Madan and Bisaria.1983). They exhibit a wide range of chemical reactions.

The cultivation of edible mushroom offers same mechanism for effective upgrading of huge quantity of lignocellulosic waste residues produced annually from agriculture, forest and industries(Kamra and Zadrazil, 1988). Conversion of inedible lignocellulosic wastes into a edible biomass is the most vital respect of mushroom cultivation technology (Rajarathnam and Bano, 1993). The edible biomass thus produced may solves the problem of protein malnutrition of the people especially in developing and under developed countries. The mushroom cultivation has become one of the most intensive and technically demanding of all vegetable cultivations practiced throughout the world. This paper presents an account of exploitation of edible mushrooms for various beneficial purposes.

MUSHROOMS AS A FOOD

Mushrooms are considered more nutritious than many other vegetables. The nutritive value of some quality Mushrooms is nearly equal to the milk. They contain high level of essential amino acids, carbohydrate, vitamins, and saturated fatty acids with a mineral content exceeding that in fish and meat and twice that in most vegetables. Fruiting bodies, in general on dry weight basis, contain about 55% carbohydrate,32% protein 2% fat and rest in ash constituting the minerals. The chemistry and food value of edible mushrooms have been extensively reviewed by several workers (Crisan and Senseands, 1987). The number of edible mushrooms species cultivated successfully is increasing rapidly. Over 60 mushrooms are cultivated commercially and 10 have reached an industrial scale in many countries. The world production of cultivated mushrooms was 3,763 thousand tonns in 1989 shared mainly by the species of *Agaricus* (37.8%), *Pleurotus* (24.2%) *Auricularia* (10.6%) and *Lentinus* (10.2%). The production of edible mushrooms in India in 1992-1993 was 11,520 tonns contributed mainly by *Agaricus bisporus* (90%) and species of *Pleurotus* and *Voivariella* (10%) (Prakash 1996).

Mycelium of edible mushrooms grown in liquid culture have been used in making soaps, tea, health drink for older people and children. This practice is specially breakfast is basically popular with edible fungi which are thought to have medicinal qualities.

Exploitation of edible mushrooms for generation of edible biomass from the lignocellulosic wastes have many advantages over other sources of protein because: -

1. They represent the example of most efficient conversion of plant waste into edible food
2. Unlike many other single cell proteins they are directly edible
3. The protein conversion efficiency of mushroom per unit of land and per unit of time is far superior compared to animal sources of protein.

MUSHROOMS AS A FLAVORANTS

Due to continuing demand for food industries for natural ingredients and flavours edible mushrooms are gaining increasing attention as a source of flavour compounds. The flavor based gastronomic appeal is one of the main reasons of consuming wild and commercially grown edible mushrooms. Certain non- volatile and substance such as L-glutamic acid short chain fatty acids, carbohydrate protein and nucleotides many contribute to the characteristic flavours in different mushroom species. Typical flavour compounds synthesized by mushroom include volatile derived from metabolism of fatty acids. Submerged fermentation technique for the production of fungal biomass that is rich in flavor is now being developed.

MUSHROOMS AS A SOURCE OF MEDICINE

The mushrooms have long been used for their medicinal and tonic properties in eastern culture particularly in China and Japan (Liu and Bau, 1980). However there has been a recent upsurge in interest in traditional remedies for the treatment of various physiological disorders through various biologically active compounds of mushrooms. More than hundred medicinal mushrooms have been identified and most of them are reported to be edible (Yang and Jong, 1989).

Medicinal part of mushroom is generally the fruiting bodies but the sclerotia, mycelia or even mycorrhiza can also be used. Pharmaceutical components of some mushrooms and their pharmacodynamic effects have been compiled recently by Pai *et al* (1990), presented in table shown below: -

Table : Pharamaceutical components of mushroom species and their medicinal effects

Pharmacodyanamic	Components	Species
Anti-bacterial effect	Hirusitic acid	Many species
Antibiotic effect	E-β methoxy acrylate	*Oudemansiella radiata*
Anti-viral effect	Polysaccharide, Protein	*Lentinus edodes*
Cardiac tonic	Volvatoxin, Flammutoxin	*Volvariella* sp.
Decrease cholesterol	Eritadenine	*Collybia velutipes*
Decrease level of blood sugar	Peptide, Glycogen, Ganodran, Glucan	*Ganoderma lucidum*
Decrease blood pressure	Triterpine	*Ganoderma lucidum*
Anti- thrombus	5'- AMP, 5'-GMP	*Psaliota hortensis*
Inhibition of PHA.	r-GHP	Psaliota hortensis Lentinus edodes
Anti-tumor	β -glucan, RNA complex	Many species, Hypsizygus
Increase secretion of bile	Armillarisia A	Armillaria tabescens
Analgesic/ Sedative effect	Marasmic acid	Marasmius androsaceus
Immunomodulation	β -glucans	Lentinus edodes Schizophyllum commune
Anti-antherosclerosis	Andinocin	Auricularia polytricha
Aphrodisiac effect	Protein bound polysaccharides	Lentinus edodes

Source: Pai et al. (1990)

USES OF MUSHROOMS IN BIOREMEDIATION

The use of microorganisms for environmental improvement such a degradation of contaminants, pollutants and other waste products is known as bioremediation. Several edible mushrooms have found place in removal or detoxification of organic pollutants found in waste effluents, sledge sediments and landfills. Different species of *Pleurotus* have been used in the treatment of environmental pollutants like polycyclic aromatic hydrocarbon, polychlorinated biophenols, dioxines etc. (Hutterman *et al.*,1989). Caffeine contamination of watershades represents major ecological disaster in coffee growing regions of the world. Oyster mushroom can be grown commercially on a wide variety of coffee wastes, destroying majority of caffeine and rendering them into secondary products.

MUSHROOMS IN INDUSTRIES

The mushroom mycelium has ability to secrete a range of scarifying and oxidizing enzymes. The enzymes produced from the metabolism of mushrooms have many industrial applications such as:-

1. **Ligninolytic Enzymes** : This group of enzyme include phenoloxidases, peroxidases. catalases and laccases, which are responsible for lignin degradation without interfering with cellulose and hemicelluloses. Some of the species of *Pleurotus* is now being utilized in the delignification of lignocellulosic waste to produce pulp for cardboard or paper manufacture.
2. **Polysaccharide Degrading Enzymes:** The polysaccharide degrading enzymes such as xylanases and polyglacturonases of *Pleurotus* spp. offer an alternative to boiling with NaOH for removal of non cellulosic materials in the rating of flax fibers.
3. **Protein Degrading Enzymes:** In mushroom food processing, a protein degrading extract of *Pleurotus ostreatus* containing chitinases and gluconase is able to soften the tough stipes of *Agaricus bisporus*.
4. **Oxidizing Enzymes:** The oxidizing enzymes produced by *Pleurotus ostreatus* and *Coriolus versicolor* can degrade and metabolise not only native lignins but also kraft lignin and lignisulfonates. Mycelial pellets of *C. versicolor* have been used for the continuous decolorization with glucose as co-substrate, while *Lentinus edodes* can remove colour with no additional carbon source

USE OF MUSHROOMS SPENT SUBSTRATE

Mushroom spent is the substrate which is left behind after the termination of mushroom crop. When fruiting fungi degrade lignocellulosis, they use some of the degraded product for its vegetative and reproductive growth but many nutrients and organic matter remain unused by the mushrooms. Compared to the original substrates, spend substrate is more soluble and contains greater amount of free sugar, amino acids, cellulose with lesser degree of polymerization and a variety of degradatory enzymes. Due to the above-mentioned attributes of spent substrates, it has several applications which are as follows:

i) **Spent Substrate as upgraded Ruminant feed:** After the harvest of fruiting bodies of mushroom the lignin and cellulose bonding are modified and the digestibility of spent substrates as animal feed is enhanced along with improvement in nutritional quality of the lignocellulosic waste. Fresh coffee pulp has been used for cattle feed after the growth of *O.ostreatus*.

ii) **Spent Mushroom Compost as Soil Fertilizer and Conditioner:** Spent mushroom compost consisting of degraded cellulose, hemicellulose and lignin serves as an effective soil fertilizer and conditioner. High yielding of crops such as tomato cucurbits and beans has been reported when soil was amended with spent mushroom compost. The effect of soil amended with spent golden mushroom compost on alleviating phytotoxicity of alachlore to seedlings of garden pea have recently been reported by Huang (1995).

iii) **Spent Substrate for Cultivation of Other Mushrooms:** The waste left after mushroom cultivation contains reduced C:N ratio and altered proportion of amino acids, proteins, vitamins and minerals. Such wastes can be recycled for a second, different crop of mushrooms.

iv) **Spent Substrate as a Source of Enzymes and Production of Single Cell Protein (SCP):** A significant amount of enzyme, produced by mushrooms during its growth and development, remains in the substrate after the harvest of fruiting bodies. An extract of spent substrate of rice with saccharifying enzymes by species of *Pleurotus* can be incubated with wastes to aid in further saccharification of wastes(Madan and Bisaria, 1983).

v) **Spent Substrate for Biogas Production:** The spent substrate contains a significant amount of sugars. During fermentation, the sugar is utilized by methanogenic microorganisms present therin for their metabolic activity and biogas is produced in the process. Fermented biogas from the action of methanogenic bacteria on degraded straw represents a renewable source of energy from waste materials.

vi) **Spent Substrate for the Production of Native Silica:** The straw and husk of rice have a good content of silica which can be obtained after its biodegradation. The spent substrate, being rice straw in origin and degraded by species of *Pleurotus,* may serve as a source of native silica. With further enhancement of degradation efficiency of *Pleurotus* species, silica can be obtained in its original deposited form without recourse to heating that is associated with the ashing process

vii) **Other Applications:** Besides aforesaid uses of spent mushroom substrate, it has other applications also. Recycling of spent mushroom substrate by aerobic composting to produce novel horticulture substrate has also been reported (Nair,1976).

CONCLUSIONS

The production of edible mushroom has increased tremendously due to technical advances. Since the cultivation of mushrooms require various lignocellulosic waste, it provides a solution to many problems of global interest: substantiating protein shortage, resource recovery and waste re-use and cleaning of environment. Edible mushrooms are rich source of quality protein which can be produced with greater biological efficiency than animal protein and, therefore have immense prospects in developing countries for enriching the diet of human population suffering from protein malnutrition.

Exploitation of several and unexplored biological activities of edible mushroom is presently needed for mankind. Attempt should be made to search new species. develop newer strains through genetic breeding and protoplast fusion techniques. Attention is also needed towards the conservation of germplasm of useful mushrooms to maintain biological diversity which is a matter of global concern.

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