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## Development of value added products using mushroom: A review

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### Abstract

Mushrooms are utilised as food and medicine all throughout the world. They are regarded as low-calorie foods that are highly nutritious and include high-quality proteins and vitamins since they are an excellent source of both protein and the vitamin B complex. Mushrooms have little fat, including healthy unsaturated fat. Mushrooms have the potential to be used as a source of nutraceutical due to their high bioactive component content. They are well known for having beneficial hepatoprotective, antibacterial, anticancer, hypercholesterolemic, cardiovascular, and hyperlipidemic effects. Mushrooms can be stuffed, fried, baked, boiled, creamed, roasted, and pickled. These contain crucial amino acids like leucine and lysine that are frequently absent from recipes made with preferred grains. Due to their high amino acid content, they make a good addition to cereal. They are a fantastic complement to Indian diets that include cereal-based foods like papad, besan laddos, biscuits, cookies, and bread due to their high amino acid content.

**Keywords:** antibacterial, anticancer, hypercholesterolemic, cardiovascular

### Introduction

Mushrooms, also known as 'khumbi' or 'kukurmutta' in Hindi, are the most common type of edible higher fungi, with the ability to bio-convert inedible plant wastes directly into palatable food. Mushrooms are one of the most well-known functional foods for humans. Mushrooms are popular due to their meaty bite, umami flavour, nutritional and medicinal value. Some value-added products were created using both fresh and dried oyster mushrooms. Many high-quality products, such as mushroom biscuits, are visually and acoustically comparable to commercially available biscuits on the market. Oyster mushrooms are highly perishable and begin to deteriorate after a few hours, depending on storage conditions. (Kalac P. 2013) <sup>[1]</sup>. Because of its high moisture content, delicate texture, and unique physiology, this mushroom has a shelf life of 1-2 days at room temperature. As a result, appropriate post-harvest techniques for its long-term preservation and use are required. (Kruger *et al.* 2003) <sup>[2]</sup>. The Indian fresh mushroom market is largely contributed by marginal and small growers who, due to limited resources, must rely on the local market for the sale of their produce. Many times, growers face the problem of oversaturation in the market, resulting in distress sales at extremely low prices. The retention of fresh mushrooms at various levels, such as grower, whole seller, retailer, and consumer, contributes to this deterioration in quality of the produce and economic. Mushroom preservation methods such as drying, canning, and pickling are popular (Chandrasekar *et al.*, 2002) <sup>[7]</sup>. Surplus mushroom production during peak harvesting periods, on the other hand, can be reduced by implementing appropriate post-harvest technology to process surplus mushrooms into novel value-added products rather than simply drying and canning (Singh, S., Ghosh, S., & Patil, G. R.2003) <sup>[4]</sup>. These value-added products not only reduce post-harvest losses, but also provide additional income to mushroom growers and provide consumers with nutraceutical low fat, protein-rich food. As a result, we can now investigate value-added products like mushroom biscuits, mushroom soup, mushroom pickle, mushroom chipns, mushroom pakora, and mushroom papad. (Arumuganathan, T., *et al.* 2005. <sup>[6]</sup>

*Agaricus bisporus*, for example, has well-rounded caps, an intact veil, and a short stipe length. Mushrooms must be immediately packed and cooled (ideally by vacuum cooling), and then

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transported at a low temperature (0–1.5°C) and high relative humidity to maintain maximum quality throughout their shelf life. Apart from the control of high relative humidity, CA/MA has little benefit. O<sub>2</sub> and CO<sub>2</sub> levels of 3% and 10%, respectively, can help to prevent cap surface browning, spore elongation, and veil opening. (Saxena, S. and R.D. Rai 1990.)<sup>[9]</sup> Condensation should be avoided to avoid brown discoloration caused by bacterial colonization and quality loss, which is especially important for oyster mushrooms (*Pleurotus ostreatus*). (R. Zhang, *et al.* 2014)<sup>[25]</sup>.

Mushrooms are edible fungi that can provide a variety of nutrients. Mushrooms come in a variety of compositions and nutritional profiles. Mushrooms come in a variety of shapes, sizes, and colours. The ones that aren't toxic are also quite healthy and tasty. For many years, they have been used for their unique ability to add flavor to a variety of cuisines from various cultures. Despite the fact that they are fungi, mushrooms are classified as vegetables in the culinary world. Mushrooms add flavour without adding sodium or fat. Poisonous mushrooms can be difficult to identify in the wild, so always purchase from a reputable grocery store or market. The most common types of mushroom are: Button mushroom, Milky mushroom, Oyster mushroom, Shiitake mushroom, Enoki mushroom, Beech mushroom etc. They each have distinct appearance and taste.

They each have a distinct appearance and taste. When selecting mushrooms, make sure they are firm, not moist to the touch, and mold-free. They can be kept in the fridge for about five days in a paper bag. When you're ready to use them, brush the dirt off and lightly rinse them. Mushrooms have a variety of nutritional benefits. Mushrooms are always a good choice. They're fat-free, sodium-free, calorie-free, and cholesterol-free. They also contain a lot of fiber, vitamins, and minerals. The nutritional value of mushrooms varies depending on the type. However, they are a good source of the following nutrients in general.

*Pleurotus ostreatus* is the second most important cultivated mushroom for food purposes throughout worldwide (Chang, 1991)<sup>[3]</sup>. Nutritionally, it is rich in protein, fiber, carbohydrates, minerals, and vitamins as well as low in fat. It also has a distinct flavor and aroma (Herndndez *et al.*, 2003). According to various *P. ostreatus* mushroom investigations, the protein content ranges from 17 to 42 g per 100 g of dried fruit bodies (Khan *et al.*, 2008). Although oyster mushrooms are low in fat, they do contain some necessary fatty acids. However, mushrooms are not regarded as a substantial source of necessary fatty acids for fulfills the needs of the human body. Mushrooms are a good source of carbohydrates and nutritional fiber.

### Nutritional value of mushroom

| Principle             | Nutritive value |
|-----------------------|-----------------|
| Energy (Kcal)         | 33              |
| Carbohydrates (g)     | 6.09            |
| Protein (g)           | 3.31            |
| Total fat (g)         | 0.41            |
| Dietary fiber (g)     | 2.3             |
| Folates (µg)          | 38              |
| Niacin (mg)           | 4.9             |
| Pantothenic acid (mg) | 1.2             |
| Pyridoxine (B-6) (mg) | 0.11            |
| Riboflavin (mg)       | 0.3             |
| Thiamin (mg)          | 0.12            |
| Vitamin-D (mg)        | 29              |
| Sodium (mg)           | 18              |
| Potassium (mg)        | 420             |
| Calcium (mg)          | 3               |
| Copper (mg)           | 0.24            |
| Iron (mg)             | 1.33            |
| Magnesium (mg)        | 18              |
| Manganese (mg)        | 0.113           |
| Phosphorus (mg)       | 120             |
| Selenium (µg)         | 2.6             |
| Zinc (mg)             | 0.77            |

### medicinal uses of oyster mushroom

Oyster mushrooms are known for their culinary values in the modern world due to their high-quality proteins, vitamins, fibers and other therapeutic characteristics, and are hence referred to as nutraceutical. According to Cheung *et al.* (2008), mushrooms are regarded as a functional food that offers advantages to health in addition to the conventional nutrients they contain. Polysaccharides, lipopolysaccharides, proteins, peptides, glycoprotein, nucleosides, triterpenoids, lectins, lipids, and their derivatives are among the bioactive components found in this mushroom. Oyster mushroom reported therapeutic values like Antimicrobial or Antibacterial (Nithya *et al.*, 2009), *Pleurotus* mushroom antiviral compounds have direct or indirect antiviral actions due to immune-stimulatory activity (Brandt *et al.*, 2000), Ribonucleases identified and described from *P. ostreatus* have the potential to neutralize HIV by degrading viral genetic material (Patel *et al.*, 2012), *Pleurotus* fruiting bodies have a higher quantity of antioxidants than other commercial mushrooms. This action was mostly due to the presence of the polysaccharide pleuran, which was isolated from *P. ostreatus* and demonstrated a beneficial effect on rat colon with pre-cancerous lesions (Gregori *et al.*, 2007).

Table 1

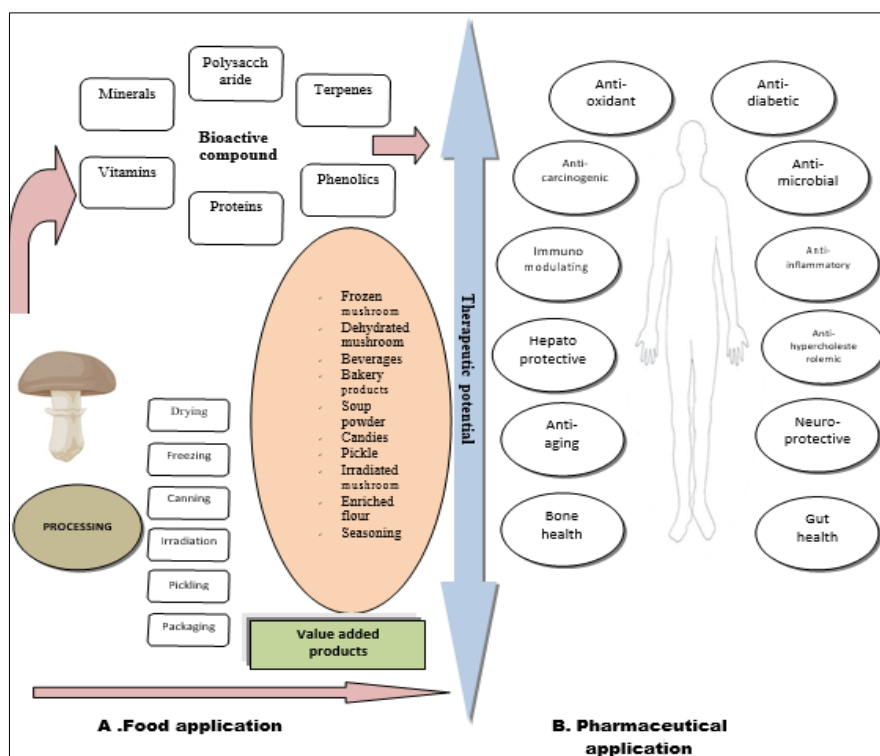
| Mushroom                                   | Appearance   | Utilization in food                                   | Supportive evidence   | References  |
|--|--|---|---|---|
| <i>Agaricus bisporus</i> (Button mushroom) | Classic appearance with a short, thick stalk and a white cap | Chips<br>Biscuit Soup<br>powder<br>Nuggets<br>Noodles | <i>Agaricus bisporus</i> lectin (ABL) stimulates mitogenicity in mice splenocytes while inhibiting proliferation in L1210 and HT-29 cells. Excellent source of the antioxidant selenium, the B vitamins riboflavin, niacin, and pantothenic acid, as well as copper. Hepatoprotective against CCl <sub>4</sub> -induced liver damage. Antitumor activity via the mitochondrial death pathway inducing apoptosis.<br>Anti-aging activity, hepatic and nephroprotective effects by improving serum enzyme activities, | J. Huang, Y. <i>et al.</i> (2016) <sup>[22]</sup><br>AD.R.A. Pires, <i>et al.</i> (2017) <sup>[23]</sup><br>F.R. Smiderle, <i>et al.</i> (2013) <sup>[24]</sup><br>Y. Zhang, G. Ma, L. Fang, <i>et al.</i> , The (2014) |

|   |   |  |   |   |
|---|---|--|---|---|
|   |   |  | biochemical levels, lipid content, and antioxidant status. Immunostimulatory and antitumor properties, inhibition of Hela cell proliferation, and close association with macrophages.   |   |
| <i>Pleurotus ostreatus</i> (Oystermushroom)                     | Pickle Jam Pakoda Patties Soup<br>Maybegrey, pale yellow or even blue with a soft velvety texture.  |  | Pleurotuseous lectin (PEL) – inhibits MCF7 and K562 proliferation. Niacin is abundant in this food. Copper and the B vitamins riboflavin and pantothenic acid are abundant. In streptozotocin-induced diabetic rats, anti-diabetic activity, activation of GSK3 phosphorylation, and GLUT4 translocation were observed. Antitumor activity, decreased colony formation capacity, and invasive abilities of the cells from BGC-823.  | Y. Zhang, T. Hu, <i>et al.</i> (2016) <sup>[27]</sup><br>Y. Zhang, X. Yang, G. Jin, <i>et al.</i> (2016) <sup>[27]</sup>  |
| <i>Agrocybe aegerita</i> (Poplar mushroom)                      | Some nutria products. And soup. It's a white rot fungi, medium-sized and having a convex cap and almost flat.   |  | It is important source of bioactive secondary metabolites and cylindan with anticancer activity. Inhibit proliferation of s180 and 4T1 cells.   | Yang, Q.; Yin, Y.; Pan <i>et al.</i> 2018<br>Zhao, C.; Sun, H.; <i>et al.</i> 2003  |
| <i>Amanita phalloides</i> (Death cap mushroom)                  | Greenish in color with white strips and gills. The cap color is Variable including white forms.   |  | This mushroom's poison directly affects the liver, and symptoms may include nausea and vomiting, followed by jaundice and coma, which will result in death. L1210 cell proliferation is inhibited.  | Lutsik-Kordovsky <i>et al.</i> 2001   |
| <i>Floccularia luteovirens</i> (Puff balls and yellow mushroom) | Using as powder. Bright yellow to orange yellow in color then late brown and has flattened brownish scales over the center. The whitish cup margin rolled inward. |  | lectin from <i>Armillaria luteovirens</i> (ALL) Yellow mushrooms are delicious and high in nutrients such as fibre, amino acids, vitamins, and many others.   | Feng, K. <i>et al.</i> 2006.  |
| <i>Boletus edulis</i> (the king mushroom)                       | Using as vegetables & snacks.   |  | Stimulate micsplenocytes mitogenicity and inhibit proliferation of human hepatocyte carcinoma G2 (HepG2) and HT- 29 cells.  | 1. Zheng, S. <i>et al.</i> 2007   |
| <i>Lentinula Edodes</i> (Shiitake mushroom)                     | Using in Medicinal purpose.   |  | Lung protection activity, antioxidant and inflammation regulation In human cervical carcinoma HeLa cells, antitumor activity was induced  | 1. Z. Ren, J. Li <i>et al.</i> (2017) <sup>[29]</sup> 2. G. Ya, A Lentinus  |
|   | It's a brown, convex caps, off- white giils tan   |  | by activating the mitochondria-mediated signalling pathway. Immuno-stimulatory. Antitumor.  | <i>et al.</i> (2017)<br>Y. Zhang, Q. Li, J. Wang, <i>et al.</i> (2016)  |
| <i>Flammulina velutipes</i> (Enoki mushroom)                    | Direct dry packaging. Its looks like long strings; almost like noodles.   |  | Immunomodulatory activity promotes the proliferation of mouse splenic lymphocytes and B lymphocytes. Antitumor activity, increased macrophage proliferation and phagocytic activity Neuroprotective properties.   | T. Feng, W. Jia, <i>et al.</i> (2016) <sup>[36]</sup><br>G. Chen, Y. Fu, <i>et al.</i> (2017)   |
| <i>Calocye indica</i> (milky white mushroom)                    | Sauces Jam Candy Pickle Direct preserve.  |  | Antioxidant and anti-aging activities, increased SOD, CAT, GPx activity, GSH levels, and decreased MDA levels in mice brain and erum. Neuroprotective activity against D- galactose-induced cognitive dysfunction, as well as antioxidant activity. In mice, there is damage and mitochondrial dysfunction.   | S. Govindan, <i>et al.</i> (2016) <sup>[39]</sup><br>Govindan, S. Keeper, <i>et al.</i> (2014)  |
| <i>Pleurotus eryngii</i> (Kingtrumpet mushroom)                 | Novel value-added products can be prepared with its like soup.  |  | Antitumor activity induced cell-cycle arrest at the S-phase and stimulated intracellular ROS production in HepG-2 cells. Hypolipidaemic and hypoglycemic activities raise the level of high-density lipoprotein. Lipoprotein cholesterol and glycogen in the liver Immunomodulatory roperties. Antitumor activity, inhibition of proliferation, and enhancement of lactate dehydrogenase (LDH) HepG-2 cell release.   | D. Ren, N. Wang, J. Guo, <i>et al.</i> (2016) <sup>[40]</sup><br>L. Chen, Y. Zhang, <i>et al.</i> (2016) <sup>[41]</sup><br>D. Xu, H. Wang, <i>et al.</i> (2016) <sup>[42]</sup><br>G. Ma, W. Yang, <i>et al.</i> |
| <i>Ganoderma lucidum</i> (The lingzhi mushroom)                 |   |  | In mice, anti-diabetic activity and insulin sensitivity are improved by regulating inflammatory cytokines and gut micro biota composition. Anti-cancer activity.  | S. Xu, Y. Dou, <i>et al.</i> (2017)<br>2. M. Jin, Y. Zhu, <i>et al.</i> (2017)  |
| <i>Ganoderma lucidum</i> (The Lingzhi mushroom)                 |   |  | In mice, anti-diabetic activity and insulin sensitivity are improved by regulating inflammatory cytokines and gut micro biota composition. Anti-cancer activity Improve occluding expression in the ileum and regulate intestinal barrier function activities decrease intestinal permeability and regulate the functions of the intestinal immunological barrier Anti-diabetic action. Anti-inflammatory properties, stimulation of Peritoneal macrophages (PMs), and contribution to the anti-inflammatory response mediated by GM-CSF in indomethacin-induced small intestinal injury. | S. Xu, Y. Dou, <i>et al.</i> (2017)<br>M. Jin, Y. Zhu, <i>et al.</i> (2017) <sup>[44]</sup><br>S. Huang, J. Mao, (2017) <sup>[33]</sup>   |

|   |   |  |   |
|---|---|--|---|
| <i>Macrolepiota procera</i> (Parasol mushroom)    |   | Bind two glycoproteins (Aminopeptidase N (CD13), integrin 31) that are overexpressed on the membrane of tumour cells and allow protein drugs to enter cancer cells.                                | I. S. Z'urga, M.P. Nanut, J. Kos, <i>et al.</i> , (2017) [49] |
| <i>Sparassis latifolia</i> (Cauliflower mushroom) | Deep earthy aroma with mild fennel and almond flavor. | Antibacterial and antifungal activity against <i>E. coli</i> , resistant strains of <i>Staphylococcus aureus</i> , <i>Pseudomonas aeruginosa</i> , and <i>Candida</i> and <i>Fusarium</i> species. | G. Chandrasekaan, Y.-C. Lee, H. Park, <i>et al.</i>           |
| <i>Aspergillus panamensis</i>                     |   | Immuno-modulatory activity, against trinitrobenzene sulphonic acid induced ulcerative colitis.   | I. R.S. Singh, H.P. Kaur, V. Rana, <i>et al.</i>              |
| <i>Stachybotrys chlorohalonata</i>                |   | Immunomodulatory activity causes lung cancer cell death by inducing apoptosis and inhibiting migration.  | I.S. Li, Z. Jiang, <i>et al.</i>                              |

**Table 2:** Pharmacology

| Property     | Test model                                  | Dose/concentration                    | Mechanism of action and Potential findings  | References                       |
|--------------|---|---------------------------------------|---|----------------------------------|
| Antidiabetic | HFD/STZ induced T2DM C57/BL/6 Mice          | 300 mg/kg                             | The expression of NF-B/TGF-B pathways.  | Chou et.al 2016                  |
|              | STZ- induced T2DM Wister rat                | 30, 20, and 10 mg/kg                  | The expression of IL-1 $\beta$ , TNF- $\alpha$ .  | Diae <i>et al.</i> ; 2014        |
|              | 3T3-Lipreadipocyte culture                  | 10, 25, 50 and 100 $\mu$ g/ml         | the expression of PPAR $\gamma$ and GLUT4, but do not exhibit PPAR $\gamma$ ligand activity; increase the expression of C/EBP $\alpha$ ;                | Joe <i>et al.</i> 2010           |
|              | STZ-induced T2DM female Sprague–Dawley rats | 10 mg/kg                              | The level of SOD, GPx and MDA; suppressed the expression of $\beta$ -catenin pathways   | Zhang, Lin, <i>et al.</i> , 2018 |
| Anticancer   | 3T3-L1 adipocytes                           | 50 mg/kg                              | Phosphorylation of Akt and Amp- activated protein kinase; Adiponectin   | Lee & Hyun, 2014 [16-17]         |
|              | Human hepatoma cell lines                   | 750 and 100 $\mu$ g/m                 | Induced apoptotic death of hepatoma cells in a Dose-dependent manner by Decreasing the expression levels of p53, cyclins D1, Cdk2, Cdk4, and Cdk6       | Youn <i>et al.</i> 2008          |
|              | BALB/c mice implanted with B16-F10 melanoma | 20 mg/kg of animal weight for 10 days | Inhibited tumor growth, and arrested tumor cells at G0/G1 phase, reduced pRb, p53, and p27 expression levels.   | Youn <i>et al.</i> 2009 [19]     |
|              | human coloncancer (HT-29) cell line         | 2.5–10 $\mu$ g/ml                     | Inhibited the proliferation of tumor cells by enhancing the expression levels of p21, p27, and p53, and suppressing the phosphorylation of Rb and E2F1. | Lee <i>et al.</i> 2015 [15]      |
|              | Human colorectal (HCT-116) cell line        | 5–20 $\mu$ g/ml                       | Suppressed tumor growth and formation of clonogenic colony, and decreased the levels of $\beta$ -catenin  | Kang <i>et al.</i> , 2015 [21]   |
|              |   |                                       |   |                                  |



### Health benefits of mushroom

Mushrooms' protein, vitamins, and minerals may be beneficial to one's health. Mushrooms are high in protein, as well as vitamins, minerals, and antioxidants. These can provide a variety of health benefits. Antioxidants, for example, are chemicals that aid the body in the elimination of free radicals. Toxic byproducts of metabolism and other bodily processes, free radicals They can build up in the body, and if there are too many, oxidative stress can occur. This can harm the body's cells and lead to a variety of health problems. Among the antioxidant agents in mushrooms are: Selenium, Vitamin C, Choline Learn more about antioxidants here. Cancer, According to the National Cancer Institute, the antioxidant content of mushrooms may help prevent lung, prostate, breast, and other types of cancer. (Lee, S. H., *et al.* 2009) <sup>[18]</sup>. Although some sources claim that selenium can help prevent cancer, a Cochrane review published in 2017 found no evidence to support this claim. Mushrooms also have a trace of vitamin D. There is some evidence that vitamin D supplementation may help prevent or treat certain types of cancer, though the effect may vary from person to person, according to a 2018 report.

Another antioxidant found in mushrooms is choline. Some studies Trusted Source suggest that consuming choline may lower the risk of certain types of cancer, but at least one other study Trusted Source suggests that it may increase the risk of prostate cancer. (Kang, J. H., *et al.* 2005.) It is worth noting that consuming a nutrient as a supplement is not the same as consuming it in the diet.

### Antioxidants

Antioxidants help to protect the body from free radicals, which can cause conditions such as heart disease and cancer. They also protect you from aging-related damage and boost your immune system. Mushrooms are high in selenium, an antioxidant. In fact, they are the most abundant source of the mineral in the produce section.

### Beta glucan

Beta glucan is a type of soluble dietary fiber that has been linked to lower cholesterol and improved heart health. It can also help your body regulate blood sugar levels, lowering your risk of developing type-2 diabetes. The most effective beta glucans are thought to be found in oyster and shiitake mushrooms.

### B vitamin

Mushrooms contain high levels of the B vitamins riboflavin, niacin, and pantothenic acid. The combination is beneficial to heart health. Riboflavin is beneficial to red blood cells. Niacin is beneficial to the digestive system and to the maintenance of healthy skin. Pantothenic acid is beneficial to the nervous system and aids the body in the production of necessary hormones.

### Copper

Copper aids in the production of red blood cells, which are responsible for delivering oxygen throughout the body. The mineral is also necessary for other bodily processes, such as bone and nerve health. Even after cooking, a 1-cup serving of mushrooms can provide about one-third of the daily recommended copper amount.

### Potassium

Potassium is essential for proper heart, muscle, and nerve function. 2/3 cup cooked Portobello mushroom contains about the same amount of potassium as a medium-sized banana.

### Scope of study

Mushrooms are a high-nutritional-value, medicinal, and functional food. It has a low calorie count, a high protein content, dietary fiber, vitamins, and minerals. It has a very promising agribusiness trend, but it has a limited shelf life. The produce must be modified to produce more durable products, thereby increasing the value of the mushroom. In India, the value addition of mushrooms is approximately 7%, which is lower than in some developing countries. As a result, there is a need to improve value addition. Soup powder, pickles, biscuits, chips, nuggets, ketchup, noodles, pasta, and candies are just a few of the novel value-added products that can be made with mushrooms.

Mushroom cultivation is a biotechnological process. There are many types of mushrooms that have a good taste and are popular among people, such as *Pleurotus sajor caju*, which is used in food as a soup powder. Tomato-mushroom ketchup with *Pleurotus ostreatus* and other ingredients has a pleasant aroma and flavour. Dried oyster mushrooms can be kept for a longer period of time and Oyster mushroom are rich source of proteins, vitamins and minerals. Oyster mushroom cultivation has short duration than other mushroom which makes its good alternative as a food.

### Value added products of mushroom

#### Mushroom preserve (Murabha)

Blanch the mushroom for 5 minutes at 85°C after washing it in 0.05 percent KMS solution. Blanched mushrooms should be washed in cold water 2-3 times before being cut into small pieces. Dip into a 50\*Brix sugar solution and refrigerate overnight. Strain the sugar solution and add 0.1 percent citric acid, enough sugar, and heat to 60\*Brix. Dip the mushroom and set it aside for the night. Repeat this process until the sugar concentration reaches 70\*Brix. Dip the mushroom in it for a week. Drain the sugar syrup and replace it in an airtight container with freshly prepared 68\*Brix sugar syrup. This can be stored for up to 6 months.

#### Mushroom candy

The process of making mushroom candy is nearly identical to that of mushroom preserve. A candied fruit or vegetable is one that has been impregnated and coated with sugar before being removed and dried. To prevent fermentation, the total sugar content of the impregnated produce is kept at around 75%. After harvesting, fresh mushrooms are washed and halved longitudinally into two pieces. Blanching the halves in 0.05 percent KMS solution for 5 minutes. These are treated with sugar after draining for 30 minutes. The sugar treatment is applied at a rate of 1.5 kg sugar per kilogramme of blanched mushroom. To begin, sugar must be divided into three equal parts. Blanched mushrooms are covered with one part sugar and stored for 24 hours on the first day. The same mushrooms are covered with the second half of the sugar the next day and left overnight before being removed on the third day. To achieve a concentration of 70\*Brix, the sugar syrup is boiled with one-third of a cup of sugar and zero percent citric acid. Mushrooms are combined with syrup and boiled for 5 minutes to increase the concentration to 72\*Brix. After

cooling, the mushrooms are taken out of the syrup and drained for 30 minutes. The drained mushrooms are placed on a sorting table to separate, reject, and discard defective and unwanted pieces. Finally, the mushroom pieces are dried in a cabinet dryer at 60°C for 10 hours. All mushroom candies are removed as soon as they become crispy, packed in polypropylene bags, and sealed. The mushroom candy can be stored for up to 8 months and has an excellent acceptability and chewability.

#### **Mushroom pakora / patties**

Maida flour (2 kg), ghee (1 kg), refined oil (200 ml), carom seed (ajwain) (20 gm), and salt (50 gm) were thoroughly combined with water. After thoroughly mixing all of the ingredients, the dough was spread into thin sheets and folded. A similar procedure (spreading and repeated seven times with a 10- minute interval between each. Following that, a dough sheet cut into small pieces and 1 kg of fried mushroom were filled into it to make patties.

To avoid stickiness of dough pieces during handling, a small amount of milk powder (50 kg) was used. Raw pieces were baked in a hot oven (180° C.) for 10 minutes to make them crunchy and crispy. Folding was repeated seven times with a 10-minute interval between each. Following that, a dough sheet cut into small pieces and 1 kg of fried mushroom were filled into it to make patties. To avoid stickiness of dough pieces during handling, a small amount of milk powder (50 kg) was used. Raw pieces were baked in a hot oven (180° C.) for 10 minutes to make them crunchy and crisp. Similarly, fresh cleaned mushrooms were cut into small pieces for oyster mushroom pakora. To make it, various ingredients such as besan (chana dal powder), onion, garlic, black and red chilli powder, turmeric powder, and salt were mixed with water.

#### **Mushroom pickle**

One and a half kg fresh oyster mushroom, graded by size and thoroughly washed in clean water to remove any foreign matter adhering to the surface for 1 kg pickle. The cleaned mushrooms were cut into small pieces and blanched immediately in a boiling solution of 0.05 percent KMS + 0.1 percent citric acid + 2% brine solution for 10 minutes. (Rai, R.D. and T. Arumuganathan. 2008.) Blanched mushrooms were subjected to a salt curing process in 10% NaCl overnight. The excess water oozed out from the mushrooms is removed the next day, and appropriate preservatives (acetic acid and sodium benzoate), salt (90 g), black mustard seed powder (35 g), turmeric powder (20 g), red chilly powder (10 g), cumin seed powder (1.5 g), fennel seed powder (100 g), garlic (1.5 g), carom seed (10 g), nigella seed (kalonji) 50g, and 200ml mustard oil are.

#### **Mushroom jams**

Harvested oyster mushroom slices 1kg blanched with 2% salt for 10-15 minutes for 2 kg jam Cold blanched mushroom slices are used in the pulping machine to make pulp. Following that, the mushroom pulp was slowly heated until it boiled, and other ingredients such as citric acid 6 g, sugar 750 g, and pectin 20 g were added to it. Continue to boil the pulp mixture until it reaches the desired brix level. After that, the pulp mixture is allowed to cool at room temperature before adding other ingredients such as apple ASS colour 10 g and sodium benzoate 20 g to achieve the desired colour, flavour, and taste.

#### **Mushroom sausages**

Cut the freshly harvested mushrooms into small pieces and cook until soft with salt. Including the 5% of saturated fat. Add a locating agent like soy protein, casein, or xanthum gum. Make it to your liking and store it.

#### **Mushroom biscuits**

Delicious and crunchy mushroom biscuits are made with oyster mushroom powder and other ingredients such as maida (3 kg), sugar (1.2 kg), ghee (300 g), mushroom powder (300 g), milk powder (200 g), coconut powder (500 g), baking powder (30 g), and water (500 ml) and 2g ammonium bichromate.

To make crunchy and delicious biscuits, sieve and finely grind all of the ingredients in an electric mixer. To make a homogeneous mixture, the ghee and sugar are thoroughly combined for 5-7 minutes on the dough kneeder. These ingredients are added to the dough kneeder for 20-25 minutes of dry mixing. Following that, 500 ml water is added to the kneeder to make the dough cohesive and homogeneous, and the process is repeated for another 10-15 minutes. After that, the dough is covered with a wet cloth for 10 minutes to cool.

Following that, a thin sheet of dough is formed and cut into various biscuit shapes using various steel dies. These raw cut biscuits are placed in steel trays in a systematic manner and baked in a hot oven at 180\* C. After 20 minutes, the baking trays are removed from the hot oven, and the biscuits are ready to serve and package.

#### **Mushroom papads**

Wash the freshly harvested mushroom in 300 ppm KMS water. Blanch the mushroom in hot water at 85°C for 5 minutes before dipping it in cold water. Cut the mushroom into small pieces and puree it in a food processor. Boil the potatoes, then peel off the skin and mash them into a paste. In a 50:50 ratio, combine potato paste and mushroom paste. Season with salt, chilli powder, cumin powder, and black pepper powder to taste. At 300 ppm, add KMS powder to the paste. Spread the papad batter in a round shape with uniform thickness on a polythene sheet in drying trays. Keep the tray in the sun or in a tray dryer set to 50°C for 5-6 hours to reduce the moisture level to 5%. Peel the dried papads and store them in polythene bags in a cool, dry place.

#### **Mushroom soup**

1 kg oyster mushroom, 12 kg tomato, maida 100 g, salt 20 g, gramme masala 20 g, roasted bread pieces 100 g, garlic 10 g, ginger 20 g, and ghee 50 g are the ingredients used to make mushroom soup.

Fresh oyster mushroom slices and other ingredients such as tomato, onion, garlic, and ginger are boiled in hot water for 10-15 minutes with 2% salt. After removing all of the ingredients from the hot water, they are finely ground to create a homogeneous mixture using an electric mixer.

The fine particles of the ingredients were then filtered out using a fine cloth. The obtained extract is boiled once more. To achieve the desired taste and flavour, fried spices with oil and maida powder are added. By adding a small amount of ghee and bread crumbs, the soup is ready to serve.

#### **Mushroom nuggets**

To make mushroom nuggets, combine mushroom powder with black gramme (urad) dal powder (1:8) and make a paste by adding the required amount of water. The prepared paste is seasoned with salt (2%) and red chilli powder (1%), and round balls of 2-4 cm diameter are formed. The prepared balls are spread out on a steel tray to dry in the sun. These

mushroom nuggets can be deep-fried and served as a snack, or they can be used in a vegetable curry.

### Mushroom chips

Fresh mushrooms harvested and washed, sliced (2 mm), and blanched in a 2 percent brine solution are used to make mushroom chips. The mushrooms are soaked in a solution of 0.1 percent citric acid, 1.5 percent NaCl, and 0.3 percent red chilli powder overnight. After draining the solution, the mushrooms are dried in a cabinet dryer at 60°C for 8 hours. Then it is fried in refined oil to make high-quality chips. After the species are mixed, the chips are sealed in polypropylene packets.

### Mushroom ketch-up

Ketchup is made by concentrating the juice/pulp of the fruits/vegetables, removing the seeds and skin. It is highly viscous and does not flow freely. They also have more sugar and less acid.

Freshly harvested mushrooms are washed, sliced, and cooked for 20 minutes in 50% water. A mixer grinder is used to make

mushroom paste. Arrarote (0.2%), acetic acid (1.5%), and other ingredients are combined in the paste and cooked to achieve a TSS of 35\*Brix. The ketchup is then placed in the sterilised bottles or jars. Ingredients: salt 10%, sugar 25%, acetic acid 1.5 %, sodium benzoate 0.065, onion 10%, garlic %, ginger 3%, cumin 1%, black pepper 0.1 %, red chilly powder 1%, ajinomoto 0.2 %, arrarote 0.2 %.

### Novel foods from Mushroom powder

Mushroom fortified corn extrudates: fortification in extrudates to a level of 20% paste and 10% mushroom powder for both single and twin screw extruders can result in acceptable quality extrudates. Vegetarian sausage made from fresh mushrooms can be made by adding 5% saturated fat and binding agents such as carrageenan, soya protein concentrate, casein, or xanthan gum. Mushroom fortified instant noodles: Prepare mushroom fortified ready-to-cook instant noodles of acceptable quality and high nutritive value by fortifying noodle dough with 4% mushroom powder.

**Table 3:** Organoleptic evaluation of oyster mushroom value added products

| Name              | Color | Appearance | Flavor | Taste | Texture | Overall acceptability | Mean | Storage period |
|-------------------|-------|------------|--------|-------|---------|-----------------------|------|----------------|
| Mushroom Biscuits | 8.2   | 7.7        | 8.2    | 8.6   | 8.4     | 8.7                   | 8.3  | 12 month       |
| Mushroom soup     | 6.9   | 6.2        | 7.7    | 7.6   | 6.9     | 7.8                   | 7.2  | ---            |
| Mushroom Jam      |       | 7.8        | 8.0    | 8.4   | 7.9     | 7.8                   | 8.2  | 8 months       |
| Mushroom Pickle   | 8.6   | 8.3        | 8.2    | 8.1   | 8.1     | 8.4                   | 8.3  | 12 months      |
| Mushroom Pakoras  | 8.4   | 8.2        | 8.5    | 8.6   | 7.5     | 8.1                   | 8.2  | ---            |

In terms of quality, oyster mushroom pickle is excellent in terms of colour, quality, appearance, flavour, taste, and texture. Similarly, mushroom biscuits are preferred for their quality, crunchiness, taste, texture, flavour, and colour. For a period of 12 months, the shelf life of both mushroom pickle and biscuits, as well as storage quality concerns in general and colour, taste, texture, and appearance in particular, are unaffected. The oyster mushroom jams, a novel product, were also liked by the panel of judges in terms of overall quality and storage, with a maximum storage life of up to 6 months reported. The taste and appearance of mushroom jam did not change during the study.

The colour of the mushroom jam, which was light brown, remained constant throughout the storage period. The other items The mushroom biscuits and mushroom pakora received the highest and equal sensory score (8.6), while the mushroom pickle and mushroom patties received the second highest and equal sensory score (8.6). (8.1). Mushroom jams and soups came in third and third, respectively (7.9). The texture and flavour of the products, which are important factors in product acceptance, are generally good and ranged from 6.9 to 8.4, 7.5 to 8.5, respectively. Mushroom biscuits ranked first in terms of overall acceptability, followed by mushroom pickle, mushroom jam, mushroom pakora, mushroom patties, and mushroom soup. Thus, the preparation of mushroom value added products not only adds value and returns additional income to mushroom growers, but also provides consumers with protein- rich nutritious food.

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