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Food Science & Nutrition Technology
ISSN: 2574-2701

The Nutritious Food Mushroom: Cultivation, Benefits and its Diversity and Utilization in Prospective of Ethiopia

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Review Article
Volume 8 Issue 3
Received Date: January 20, 2023
Published Date: September 08, 2023
DOI: 10.23880/fsnt-16000306

Abstract

Nowadays, mushroom is popular valuable food worldwide because it contain many essential amino acids and are thus good sources of protein, some unsaturated fatty acids; provide several vitamins (B vitamins, and vitamin D) as well as the minerals potassium, phosphorus, calcium, and magnesium. Mushrooms can be used as medicine for compromised health and its crude extract products mainly can be used as dietary supplements (nutriceuticals). As they use agricultural waste as substrate for their growth and biosynthesize, they reduce crop residue that cause environmental pollution and heath problem. The fungal/mushroom mycelia involved in bioremediation process and this is referred as mycoremediation. Thus, in general this review defines mushroom, give its historic background, and shows the different types of mushrooms, application in different disciplines like medical, environmental and bioremediation. And also this review describes different medium of mushroom, spawn running and types of fermentation used. Specifically, it also discusses the mushroom diversity in Ethiopia, utilization of wild edible mushroom as well as it discusses the attempts made to cultivate mushroom and the challenges have been faced the business In Ethiopia.

Keywords: Mushroom; Cultivation; Benefits; Diversity

Abbreviations: SSF: Solid-State Fermentation; MM: Medicinal Mushrooms; SMEs: Small and Medium Enterprises.

Introduction

A mushroom is the fleshy, spore-bearing fruiting body of a fungus, characteristically produced above the ground on soil or on its food source, mostly in forests. It is perhaps the most well-known and documented edible forest product [1]. Mushrooms are mysterious, cultural, traditional and very famous in contemporary society [2]. Edible mushrooms were only traditionally harvested wild and were difficult to domesticate and cultivate. Collection from wild woodlands is still important in the world and particularly in southern Asia [3,4] and other developing countries [5]. The main cultivated mushroom species worldwide are *Agaricus bisporus* (Button), *Pleurotus sp* (Ostery) and *Lentinula edodes* (Shiitake) [6]. In the natural environment, mushrooms grow on variety of substrates, especially those containing lignin and cellulose, often abundant during the rainy season [7]. Their fleshy, spore-bearing fruiting bodies grow on soil or wood substrates whereas some exist in mycorrhizal relationship with trees [8]. Mushroom production has now become popular all over the world. It has been described as the most versatile and prolific agricultural venture all over the world [9]. World production of mushroom is about 40 million tons while production of mushroom in China in 2017 was 31.7 million tons which is roughly 47% of the world supply of mushroom [10]. China is the world's leader in production, consumption and export of mushroom while USA (11%), The Netherlands (7%), Poland, Spain, France, Italy, Ireland, Canada and UK are the other leading mushroom producers. The recent update shows that the market had a value of $35 billion in 2015. Mushroom market in the world is expected to reach US$ 69.3 bn by 2024 [11].

Edible mushrooms possess high nutritional value, including protein (35%), crude fibre (19%), and carbohydrates [10]. Mushrooms are highly recognized for their medicinal values and said to have antitumor, antiviral properties like anti-HIV and anti-hepatitis B and remove serum cholesterol from the blood stream [12]. They also contains natural ingredients which are very effective in normalizing blood pressure, lowering blood cholesterol and blood sugar level, protecting the liver, controlling some types of cancers, boosting the body's immune systems and hence in promoting general fitness [13].

Mushrooms play an important ecological role in the management of ecosystems [13]. Mushroom cultivation is used in bioconversion and recycling of organic matter, reduces pollution and applied as organic manures to the land after harvesting of mushrooms Taking these in Consideration, this paper presents the whole cultivation processes, type of substrate used and benefits of mushroom in different aspects and it also discusses utilization of mushroom and its diversity in prospective of Ethiopia

Types of Mushroom

The major mushroom varieties of commercial importance are Button (*Agaricus bisporus*), Oyster (*Pleurotus sppecies*), Paddy Straw (*Volvariella sppecies*), Shiitake (*Lentinula edodes*), Milky Mushroom (*Calocybe indica*), winter mushroom (*Flammulina velutipes*), Reishi (*Ganoderma lucidum*), Black Ear (*Auricularia sppecies*) and others [14].

Agaricus Bisporus (Button Mushroom)

Commonly known as white button mushroom is an edible basidiomycete mushroom and mostly cultivated mushroom. Historical evidence indicates that this mushroom was first cultivated in France and that cultivar strains originated in Western Europe [15,16]. This groups of edible mushrooms is nowadays widely used and studied for its medicinal and therapeutic properties [17,18]. Its fruit bodies exhibit antimutagenic, anticarcinogenic, and immunostimulative activities [19,20]. *Agaricus bisporus* mushroom is a useful bio-factor for agrowaste recycling and can be grown on various Agricultural residues. *A. bisporus* has many dietary usages due to its content of proteins, carbohydrates, low calories, trace elements, and vitamins and it used for synthesis of nanoparticles with antimicrobial and anticancer activities [21]. Extract from *A. bisporus* has been prevented breast cancer cell proliferation [22].

Lentinula Edodes (Shiitake Mushroom)

Lentinula edode is one of the most important edible mushrooms that cultivated globally second to the button mushroom *Agaricus bisporus* and it is the most popular fungus cultivated in China, Japan, and in some other Asian countries [23]. For a long time, this mushroom has been valued for its unique taste and flavor and as a medicinal tonic. It can be cultivated either on wood log or on synthetic substrate logs [24, 25]. *Lentinula edodes* is a white-rot fungus belonging to the Basidiomycetes, growing in dead wood of broad-leaved trees in nature [26]. *Lentinula edodes* is widely cultivated and consumed in the Orient for its nutritional values and pharmacological effects. Variety of bioactive compounds isolated from *L. edodes* (e.g. laccase, lectin, lentinan and phytase) has shown different functions, especially the effect of antioxidant, antitumor, antiviral and antimicrobial [27-30]. As one of the famous edible fungi, *L. edodes* is a good source of functional food or drugs due to its biological activities and no toxicity nor serious side effects [31].

Oyster Mushroom (*Pleurotus Ostreatus*)

Is comparable to the high temperature species in the group of Pleurotus (oyster) mushrooms, with high temperatures required for fructification. This mushroom has a promising prospect in tropical and subtropical areas. Its cultivation is easy with relatively less complicated procedures [24,32]. This mushroom can cultivated in both tropical and temperate environments [33] and it attained great attention throughout the world due to varied temperature propagation as well as utilization of lignocellulosic wastes as a substrate [34,35]. The mycelium and fruiting body of oyster mushroom could grow under a wide range of temperatures, from 10 to 3°C [36].

Medicinal Mushroom

In most Asian countries including China, it was believed that medicinal mushrooms had the power to enhance long life and liveliness [37]. In present time, medicinal mushrooms are regarded as functional foods and exist as over-the-counter health supplements used in complementary and alternative medicines [38,39]. There are many medicinal mushrooms known for their use as a source of therapeutic bioactive compounds. Among these, this review focused on some of these medicinal mushrooms such as Ganoderma, *Auricus brasiliensis,* and Chaga mushrooms.

Agaricus Brasiliensis

Almond mushroom – *Agaricus brasiliensis* is an edible mushroom originated from southern Brazilian rain forest [40]. The *A. blazei* is a type of mushroom that habitat organic litter and capable of digesting of complex plant cell wall components [41]. Recently, it was discovered that both mycelium and fruiting bodies of almond mushroom unusually have high concentrations of beta glucans, immune-potentiating polysaccharides, which also inhibit the growth of malignant tumors [42]. This mushroom commonly cultivated at the industrial level in Japan, China and Korea [43]. It has been proved to be not only a good tasting and highly nutritious mushroom, but also an effective medicinal mushroom, particularly for anti-tumor active polysaccharides. There are research findings indicating that, the bioactive substances extract from fruiting bodies of *A. brasiliensis* exhibit antibacterial [44], antiviral [45] and antiallergenic properties [46,47]. Moreover, it reduces blood cholesterol level, stimulates the immune system and it is effective in AIDS treatment [18].

Ganoderma Lucidum

Ganoderma lucidum (Fr.), species of wood degrading basidiomycete which is one of the most popular medicinal mushrooms in China, Japan, Korea, and other Asian countries [48]. Among cultivated mushrooms, G. lucidum is unique in that its pharmaceutical rather than nutritional value is paramount [49]. A variety of commercial G. lucidum products such as powders, dietary supplements, and tea are produced from different parts of the mushroom, including mycelia, spores, and fruit body. These products attributed health benefits like control of blood glucose levels, modulation of the immune system, hepatoprotection, bacteriostasis, and more [49]. In addition to numerous pharmacological effects this mushroom has key role in the environment as decomposer in nutrient cycle [50]. *G. lucidum* grows on the decaying and dead logs of deciduous trees (willow, oak, sweet gum, maple, elm and coniferous trees [51].

Chaga Mushroom

Chaga mushroom is another promising candidate in the field of medicinal mushrooms, which is mainly distributed in temperate to coldest regions [30], as well as low-latitude areas. Chaga mushroom, *Inonotus obliquus*, was used as food and nutrient food and traditional herbs in Russia, China and Japan, with anti-inflammatory and anticancer activities [52]. This mushroom has gained attention worldwide, due to its medicinal values such as antioxidant, anti-inflammatory, antidiabetic, antiviral and many others [53-55].

Substrates for Mushroom Cultivation

Mushroom substrate has been defined as a ligno cellulose material which supports the growth, development and fruiting of mushroom [56]. Vast quantities of renewable lignocellulose wastes such as rice and wheat straw, banana leaves, cottonseed hulls, corncob, sugarcane baggase, sawdust etc can be used as a substrate for mushroom cultivation. The amount of nutrition requirement differs according to mushroom species and types of substrate used [57]. They have immense abilities to utilize various lignocellulose substrates with the aid of extracellular enzymes capable of degrading complex organic material. Mushrooms play an important role in managing organic wastes whose disposal have become a problem and are causing massive pollution to the environment as a result of dumping of agricultural. The wide range of plant waste that have been reported include sawdust, paddy straw, sugarcane baggage, cornstalk, corn cobs, waste cotton, leaves and pseudo stem of banana, water hyacinth, duck weed, rice straw used as a substrate for mushroom production. Utilization of agricultural wastes for mushroom cultivation not only increases nutrient cycling in the environment but the by-product of mushroom cultivation is also a good source of manure, animal feeds and soil conditioner.

Substrates for Spawn Preparation

Mushroom spawn is the mushroom mycelium growing on a given substrate and serves as the planting material (seed) in mushroom production [58]. The spawn production involves three basic steps: pure culture preparation, mother spawn preparation and spawn multiplication/commercial spawn preparation [59]. For the spawn preparation cereal grains including: sorghum, Millet, and wheat can be used as a substrates [58,60].

Determinant Factors of Mushroom Production

Cultivation Conditions

Mushroom survival and multiplication are related to a number of factors, which may act individually or have interactive effects among them. Chemical composition, water activity, ratio of carbon to nitrogen, minerals, surfactant, pH, moisture, sources of nitrogen, particle size, and amount of inoculum, antimicrobial agents and the presence of interactions between microorganisms are considered as chemical, physical and biological factors that are linked to mushroom production [61]. The main environmental factors includes temperature, humidity, luminosity and air composition of the surrounding substrate, such as concentration of oxygen and carbon dioxide [62].

Composition of Substrates

Substrates used in mushrooms cultivation have effect on chemical, functional and sensorial characteristics of mushrooms [63]. Agro-industrial waste is produced in huge amounts, and it becomes an interesting substrate, due its commercial exploitation as well as associated environmental problems [64].

Temperature of the Culture House

The major ecological factors that affect stalk height, stalk diameter and cap size in mushroom are air temperature, humidity, fresh air, and compact material [62]. Oyster mushroom can grow at moderate temperatures, ranging from 18 to 30 _C [65]. According to Ahmed, et al. for the cultivation of *P. high-king, P. ostreatus* and *P. geesteranus*, temperature of culture house was maintained at between 22 and 25°C. Similarly, Kim, et al. [66] also cultivated *P eryngii*, where incubation room temperature was maintained at 22–24°C. According to Hoa and Wang [67], the optimal temperature for both *P. ostreatus* and *P. cystidiosus* was found to be 28 _C. Neelam, et al. [68] indicated that the optimal temperature for mycelium growth in oyster mushroom *P. florida* was 25–30°C. The optimal environmental situation for mycelial growth and the subsequent fruiting is usually very distinct. Fruiting body development is often induced after drastically altering environmental circumstances [69]. In the solid-state fermentation systems, during the fermentation process, the temperature of fermenting mass increases due its respiration [70]. High temperatures in growing environment can reduce mushroom development in different ideal growth tracks, allowing the development of competitive microorganisms better adapted to high temperatures [71]. As result of these situations it needs to operate and control the temperature of mushroom cultivation environment as much as possible.

Humidity

For most fungi, the wide humidity range is 20–70% [72]. As reported by Li, et al. [73], the appropriate humidity during the darkened spawn-running and mycelia stimulation should encompass a range between 60–75% and 85–97%, respectively, in the environment, enabling a satisfactory growth of Pleurotus spp. High humidity is favorable for pining and fruiting [69]. During the *P. high-king, P. ostreatus* and *P. geesteranus* growth on wheat bran-supplemented sawdust, the relative humidity of the culture room was maintained at 80–85% by spraying water three times per day. Similarly, Ryu, et al. [74] also cultivated *P. eryngii* where the humidity of the incubation room was maintained at 85–95%.

Air Composition

Gaseous environment control in aerobic solid-state fermentation is an important factor in the development of microorganisms, dependent on oxygen flow speed through the substrate and the speed of O2 consumption by microorganisms. Aeration has different functions, being O_2 provision for aerobic growth and metabolism; moisture regulation; temperature adjustment; water vapor, CO_2 and some volatile metabolite elimination. Aerobic mushrooms require oxygen for their survival and development. During the darkened spawn-running, it is important to keep CO_2 concentration at 2000–2500 mg L_1. After the completion of spawn-running and mycelia stimulation, fruit bodies were allowed to develop at CO_2 concentration 1500–2000 mg L_1 [73]. Since air contains high CO_2 levels, it will produce mushrooms with thick and short stipe pileus [71]. Therefore, during the fruiting stage is a reduction in CO_2 concentration is required, as well as an increase in O_2. This is possible by opening packages of cultivation and ambient air change through ventilation (rational room cubic capacity/cultivation area in cubic meter ration should not be lower than 1.85:1). The maximum number and size of holes (air entrance) can be made, provided that there is no contamination by being careful not to damage the mycelium [75].

Types of Fermentation Suitable for Mushroom Cultivation

The solid-state fermentation (SSF) is a process in which microorganisms grow on solid materials or inside solid porous particles in the absence of free water; the final result is a nutritionally enriched product, with a higher content of proteins and vitamins than the original substrate [76]. Now a days there has been a growing interest in SSF technology to obtain a wide variety of products, such as enzymes, pigments, aromatic compounds, flavoring, hormones, acids, alcohols, proteins, antibiotics, spores, among others [77,78]. There are research results on new applications of SSF for the control of the environment, treatment and biodegradation of hazardous or undesirable compounds, and detoxification of agro-industrial waste [79,80]. An interesting industrial application of SSF, known as "Phase 2", is the preparation of a selective substrate employed in *A. bisporus* mushroom cultivation [81,24]. Edible mushrooms are widely cultivated for use in gastronomy. In SSF Cultivation takes a 150-hour lapse and is divided into 3 isothermal stages: preconditioning (40°C, 40h), pasteurization (55°C, 10h) and conditioning (40°C, 40h) [82]. The air and temperature conditions are experimentally determined and validated in industry, based on restricted knowledge of the SSF phenomena. The objective is to produce microbial populations, which encourages growth of the *A.bisporus* during the cultivation stage, such as the *Scytalidium thermophilum* and some Actinobacteria whilst eliminating competitors and inhibitors [83]. These approaches provide a good technical and economic starting point for large-scale experimental work. The major challenge in the SSF process scale-up is the heat removal from the bed of solids with inter- particle air [84,85]. For large-scale SSF bioreactor design, evaporation is one of the most effective heat removal mechanisms. However, continued evaporation can dry the bed out to water activities enough to restrict growth rates and product formation [85]. Therefore, the maintenance of the water activity of the bed becomes a consideration, which guides design and operation.

Benefits of Mushroom

In addition to being used as source for nutritious protein-rich food, mushrooms can also contribute to the production of effective medicinal products [86,87], reduction of environmental pollution through bioconversion of lignocellulosic wastes [88]. Another influential role of mushroom is bioremediation in which mushroom used to remove and break down as well as absorb the pollutants (biosorption process) [25,89,90]. With no adverse legal, ethical, or safety effects, this form of bioconversion technology has not only favorable socio-economic, nutritional, and health benefits, but also raises employment possibilities (increases job opportunity) and has a positive environmental impact [91].

Medicinal Benefits

Medicinal mushrooms (MM) can be defined as macroscopic fungi, which are used in the form of extracts or powder for prevention, alleviation or healing multiple diseases, and in balancing a healthy diet. There is a total more than 130 medicinal functions produced by MMs and fungi [92]. The medicinal properties of mushrooms have been confirmed through an intensive research conducted worldwide [14]. Mushrooms possess immense nutritional and medicinal bio-components that substantiate their usage in maintaining global public health. The mushroom composed compounds like polysaccharides, complexes (polysaccharide–protein and polysaccharide–peptide), ribonucleases, proteases and lectins. Other mushroom compounds includes some low molecular weight secondary metabolites, such as lactones, terpenoids, and alkaloids, antibiotics with different chemical groups, and metal chelating agents [93,94]. Mushrooms possess antioxidant activity, anti-hypertensive activity, hypocholesterolemic activity, liver protection, as well as anti-inflammatory activity, anti-diabetic activity, anti-viral activity, and anti-microbial activity [95]. For example, G. lucidum polysaccharides protect fibroblasts against UVB-induced photoaging [96]. G. lucidum also showed strong anti-inflammatory activity and it acted as an immunomodulator in inflammation induced by a high-cholesterol diet [97]. The Coriolus versicolor (*Trametes versicolor*) shows in vivo and in vitro anti-tumor and anti-metastasis effects on mouse mammary 4T1 carcinoma [98]. Apart from those mentioned above, mushrooms are also considered a potential source of prebiotics as they contain different polysaccharides, such as chitin, hemicellulose, mannans, and glucans, galactans, and xylans [99].

Environmental Benefits

Degradation of Organopollutants

Bioremediation is a very important technique that involves the use of mushroom mycelia to remove or neutralize a wide variety of pollutants [100,101]. In order to clean contaminated land, various examples include: spent oyster mushroom substrate performing better than many mushrooms for denaturing of biocide pentachlorophenol [102] removal of biocide pentachlorophenol in water systems using the spent mushroom compost of *Pleurotus pulmonarius* [103]; use of spent mushroom compost to bioremediate; mycoremediation (bioremediation with fungi)—growing mushrooms to clean the earth [104]; removal of Escherichia coli from synthetic storm water using mycofiltration [105].

Bioconversion of Agricultural Wastes

Organic solid wastes are a kind of biomass, which are generated annually through the activities of the agricultural, forest and food processing industries. They consist mainly of three components: cellulose, hemicellulose, and lignin. The general term of these three main building blocks of plant fiber is known as lignocellulose [106]. These are organic compounds composed of long chains of carbon and hydrogen, structurally similar to many organic pollutants. Mushrooms, with other fungi, are presently only organisms that can synthesize and excrete the relevant hydrolytic and oxidative enzymes that enable them to degrade complex organic substrates into soluble substances, which can then be absorbed by the mushrooms for their nutrients [24]. Different species of mushrooms have different abilities to utilize the substrates. This depends on the particular enzymes secreted by the individual mushroom. Examining the lignocellulolytic enzyme profiles of three important commercially cultivated mushrooms exhibit varying abilities to utilize different lignocellulolytic as growth substrate [107].

Mushroom in Ethiopia

Diversity Study of Ethiopian Mushroom

Several studies have been conducted to determine taxonomy and ecological diversity of wild mushroom in Ethiopia. Some of the edible mushroom in Ethiopia includes: *Agaricus arvensis, A. campestroides, Laetiporus sulphureus, Termitomyces microcarpus, T.clypeatus, Lentinus sp., Schizophyllum commune* and *Dictyophora indusiata*. Among these species, L. sulphureus and S. commune are well exploited for their ethnomycological use in Ethiopia as it was documented by Tuno [108]. Habitat information for commonly used species was mainly in natural forests, grazing areas and termite mounds [109]. A total of 20 ethnomycologically important wild mushroom species belonging to ten genera and six families were identified, of which 15 were reported to be edible in the Menge District, Asossa Zone, Benshangul Gumuz Region [110]. Megersa S, et al. [111] has been reported that more than 116 macrofungal species were recorded in the Dagaga-Gambo plantation and natural forests. Zeleke and coworkers have conducted a research on the traditional knowledge and uses of wild mushroom species of three ethnic groups (Amhara, Agew and Sidama) in Ethiopia [112]. The geographical location of wild edible mushroom growing areas is indicated on the following map.

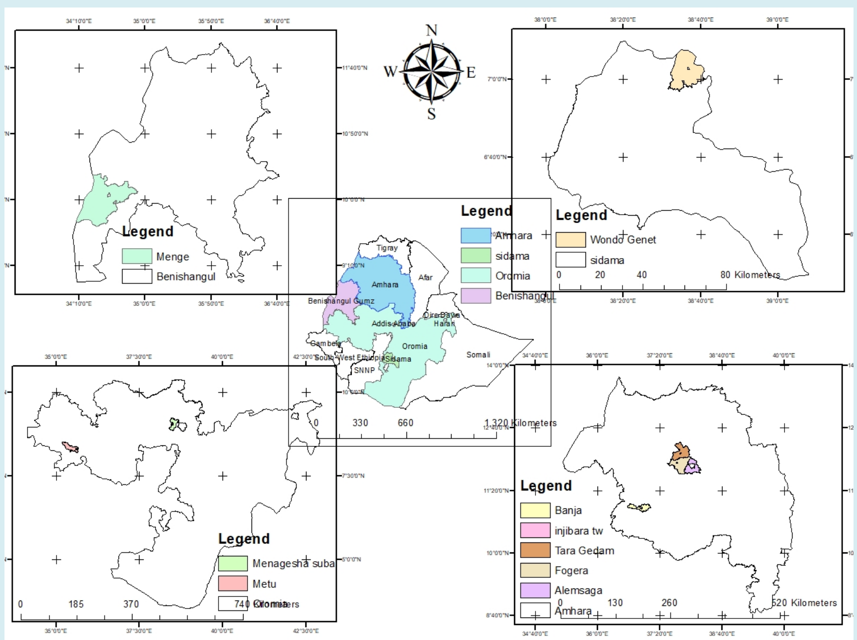

Figure 1: The map of wild edible growing geographical areas in Ethiopia.

Mushrooms Utilization in Ethiopia

Mushroom has been used as food in Ethiopia particularly in southwestern part of the country. Mushroom locally called by different names in different regions of the country and the habit of mushroom consumption differs from region to region. Some studies indicated that wild edible mushrooms gathered from the natural forests and utilized as a food source in southern Ethiopia. For example, hunting wild mushrooms is traditional and cultural practice in Kaff ethnic groups [109]. Similarly have been reported collecting wild edible mushroom from natural forest and utilization of it as sources of food supplement in the Bonga area is common practice. in Benihsnagul Gumz region, Gumz and Berta tribes Collect wild edible mushroom and utilize it as valuable food sources during food shortage periods (rainy season).

Current Status of Mushroom Business and Its Challenges in Ethiopia

Mushroom Business

Mushroom farming has become attractive business in agricultural sector due to its simplicity and flexibility of cultivation and quite profitable [113-127].

Cultivation and exploration of mushrooms in Ethiopia has been started a decade ago with the trial made with Oyster mushroom (*Pleurotus ostreatus*) followed by button mushroom, Agaricus sp. and Shitakke mushroom, Lentinus sp. It is considered quite promising business which mushroom producers turn into potential Small and Medium Enterprises (SMEs). However, lack of appropriate training, awareness and yield performance are the reason to the reduction of production. Hence, creation of new products through research or qualitative improvement in existing products, the use of new industrial processes or creation of new market openings, or the development of new raw-material sources and other new inputs or forms of industrial organizations helps to increases the business.

Mushroom Market

World production of mushroom is about 40 million tons while production of mushroom in China in 2017 was 31.7 million tons which is roughly 47% of the world supply of mushroom [10]. China is the world's leader in production, consumption and export of mushroom while USA (11%), The Netherlands (7%), Poland, Spain, France, Italy, Ireland, Canada and UK are the other leading mushroom producers. The recent update shows that the market had a value of $35 billion in 2015. Mushroom market in the world is expected to reach US$ 69.3 bn by 2024 [11]. In Ethiopia there is no such huge commercial mushroom farm that can reach the demand of large cities and towns. According to the market survey conducted in 2006/07 in Addis Ababa, supply of fresh mushrooms is close to zero. Currently, some small scale producers sell their products to large scale producers. Large scale producers, produce, buy process and export mushrooms. These show that Cultivation and business of mushrooms is an untouched and wholly vacant business sector in Ethiopia. Therefore, research and training support is critically needed at all stages.

Challenges

Although mushroom cultivation getting consideration among the small and large scale farmers, there are some problems which stagnate the mushroom cultivation in Ethiopia. Among these, lack of institutionalized sector for mushroom cultivation and utilization, lack of the availability of quality spawn , limitation of skills and experience among mushroom cultivators, lack of marketing system and there is no national quality control mechanisms and safety assurance.

Conclusion

The importance of mushroom cultivation for food security is high. The great benefits of mushroom-derived dietary supplements, medicines and new foods are already available in the global markets, but in Ethiopia due to the negative tendency of their use as this food in the absence of skills. Different ethnic groups in Ethiopia have a good traditional knowledge and practices in the utilization of wild edible mushrooms. However, the involvement of organizations, institutes and civil societies in the disseminating of indigenous knowledge and the attempt to document, utilize, and conserve these nutritious food is very poor. The Ethiopian population is increasing in alarming rate which can be directly influence livelihood of the communities as whole by increasing the demands for food. Thus, domestication and cultivation of indigenous varieties of mushroom by using cheap agricultural wastes can be taken as solution for food insecurity, environmental pollution and unemployments.

Conclusively, more research should be done in the food and agriculture industry to increase the availability and mushroom production in the Ethiopian market and make them dominate as vegan protein sources, meat analogs, food supplements, and aroma or taste preservatives. Therefore, the present article is an attempt to review the available information regarding the mushroom cultivation and benefits, current status and utilization of mushroom in Ethiopia.

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