Ethiopian Biodiversity Institute (EBI)

Enhancing Mushroom Production and Consumption Trend in Ethiopia

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Contents

1. Introduction

Rapid human population growth and drought in Ethiopia have resulted increasing poverty levels as well as malnutrition (Von Braun & Olofinbiyi, 2007). Women & children are more vulnerable group to malnutrition (Olofin et al., 2013). Artificial cultivation of edible mushroom offers a unique opportunity to solve food and health related problems.

Mushroom is a macro fungus belongs majorly to basdiomycota division. Globally about 140,000 mushroom species are estimated. It includes edible (54%), medicinal (38%), non-edible and poisonous (8%). Nutritionally mushroom is a complete heath food and suitable for all age groups. They are rich in protein and contain all the nine essential amino acids, dietary fiber, vitamins and minerals and relatively low in calories and fat but rich in chitin. Approximately 700 mushroom species are considered to be safe and could be a good source of bioactive compounds having various degrees of medicinal properties. After cultivation mushroom spent or waste also used animal feed and may improve animal health by increasing antioxidant capacity (Hamza et al., 2024).

At global scale currently mushroom farming is being practiced in more than 100 countries. 60 mushroom species have been cultivated commercially and 20 are cultivated on large industrial scale. The mushroom most produced worldwide is *Agaricus bisporus* followed by *Pleurotus ostreatus*, *Lentinula edodedes*, *Auricula auricular*, *Flammulina velutipes*, *Volverila volvovocea*, *Grifola frondosa*, *Pholiota nameko* and *Ganoderma lucidum.* Currently the global mushroom market has reached significant growth $62.44 billion in 2023. Nearly 42% of the world mushroom production takes place in China, 12 % in the USA, and 8% in the Netherlands (Sheferaw, 2021).

Ethiopia in between of the years 1997-2020 imported mushroom from 29 different countries an average of 88.3 tones /year and spent US$ 154,199, and has exported mushrooms to a total of 12 countries. About 85.7% mushrooms produced from Ethiopia were exported to Yemen; the incomes generated from the export of mushrooms from Ethiopia were much less than the expenditure to import the mushrooms yearly on an average of US$ 124971.5. (Sheferaw, 2021).

Mushroom production process involves a number of different operations including the selection of an acceptable fruiting culture of the mushroom, Selection of raw materials, Preparation of the Substrate,

Sterilization/ Pasteurization of substrate, spawning, Inoculation and Incubation. After the inoculation bags are moved to dark incubation rooms where the temperature is optimized to 20-28^{0}C.They are kept in the incubation rooms for about 15-25 days. Favorable growing conditions involve 80%- 90% of relative humidity, 55-65% moisture, ample ventilation, The CO_2 concentration should be 0.08-0.15 % depending on mushroom species. All growth parameter in different mushroom species also different in spawning phase, pinhead phase and fruiting body phase. Post harvest management and handling are also critical stage(Sharma, 2018).

Wild mushroom hunting and utilization is a traditional common practice among the different tribes in Ethiopia. However the country is very heterogeneous, with 10 ecosystems, but wild mushroom diversity remains unexplored as most regions and habitats in the country. Mushroom in Ethiopia ecologically exist as (1) mushrooms in indigenous forests, (2) grazing lands, (3) termite mounds and (4) exotic tree plantations in the form of saprophytes, parasitic and mycorrhizal. Some species reported especially collected from southern part like Kaffa and Asosa such as Termitomyces species, *Agaricus campestris*, *L.sulphureus* Agrocybe spp., and Calvatia spp (Dejene et al., 2017) (Decock et al., 2005) also reported *Fomitiporia tenuis* and *F. aethiopica* were newly record to the world. Artificial mushroom cultivation and its research is a recent activity in Ethiopia started in 2001.Therefore this underutilized wild mushroom species need domestication and serve to combat food shortage and malnutrition.

2. Ecosystem Service of Mushroom

Mushroom provide all ecosystem service categories involved in provisioning, regulating, supporting, cultural and ecosystem good service like food provision, bioremediation of toxic pollutant and decomposing of agro /or industry waste, nutrient recycling and transfer essential nutrients, facilitate absorption, especially in nitrogen/phosphorus limited environments and role in carbon sequestration in the forest. Climate regulation via by sequestering of emitting greenhouse gases. Many industrial products, fine biochemical, biocides, food additives, and enzymes for processing food and other goods, have been developed from metabolites originating from mushroom isolated from natural ecosystems. Source of recreation in picking mushroom in the forest. Moreover mushroom has mycorestoration advantages (Kewessa et al., 2023).

3. Opportunity for Mushroom Cultivation

- Mushrooms require short production period (25days-1month) and production is throughout the year not season dependent.
- It can grows locally available chip agricultural and industrial waste raw materials (Coffe husk,teff straw, cotton seed, straw etc)
- Require little land and can be made at home
- Do not require light & large amount of water
- It has high value international crops with growing global market
- Require simple cultivation materials
- It is used for job creation for many unemployed youth, women and handkiped individuals.

4. Mushroom Cultivation on Agro Industry Wastes

Mushroom cultivation for food requires basic steps starting from getting pure culture either from spore or tissue up to fruiting body production. Evaluation and bioconversion efficiency of oyster mushroom on agro-industrial waste was studied. Oyster mushroom culture was grown on potato dextrose agar (PDA) media and pure culture transferred to four types of grain (wheat, sorghum, millet and baggasse) to keep alive the mycelium viable. Substrate optimization and bioconversion efficiency study on cotton waste, teff straw, coffee pulp, and wood chips at 50:50and 90:10 ratio formulation and combination were done. The study result revealed that sorghum was selected the best for mother spawn making and propagation. The highest bioconversion efficiency of mushroom (79%) was recorded in a combination of cotton waste + coffee pulp at50:50 ratios within 25 days(Fig.1).In the same procedure in one of Ethiopian Agaricus wild mushroom species tissue culture development study was carried out on different growth media. its tissue culture is sustained and viable best on PDA media (Fig.1.). After evaluating the bioconversion efficiency of Oyster mushroom species on agro industry waste at laboratory scale and its effectiveness, the practice was shared to different community groups through training (Table .1).

Fig.1. (A) Oyster mushroom cultivation and yield evaluation on agro-industry waste (B) Ethiopian wild mushroom tissue culture development at laboratory scale

5. Training on Mushroom Cultivation and Utilization on Agro industrial Waste

Training Area	Number of trained individuals		
	Male	Female	Total
Holeta	17	3	20
Bonga	70	30	100
Adama	70	15	85
Tigraye/Mekele	35	5	40
BahirDar	32	8	40
Harer	30	15	45
AddisAbaba private producer	1	2	3
Ethiopian Biodiversity female employer	0	32	32
		Total	365

Table.1. Number of trained individuals and community group in different area and intitutes to share the best practice about mushroom cultivation and utiization

Fig.2. Training to Holeta Agriculture biotechnology research Institute

Fig.3. Training to Tigraye agriculture biotechnology institute, Mekele University and different community groups

Fig.4. Training for farmers & different community group at Bonga /keffa

6. Impacts of the Best practice

Biodiversity Conservation and Ecosystem Service

- After training and awareness creation about the use of mushroom, society aware to keep their forest a home for many wild mushrooms.
- People livelihood where depending on selling fire wood, charcoal shift into mushroom prouction and getting income to reduce the direct forest destruction.example Bonga area
- Researcher awarness raised to make survey and conserve wild mushroom at genebank

Socioeconomic

- Small scale entrepreneurs and mushroom producer are created in mushroom farming and spawn producing
- 31 privte mushroom producer youth at Adama are established and 4 individual at Holeta after training.
- yofbina engudye producing PLC, menagesha integrated organic farm, Wagnose PLC, Shitaki International mushroom company are engged in mushroom businuse and they

Technology

- Small scale mushroom cultivation need locally available and chip simple technology that everybody can produce mushroom at home
- Example Barrel,polyethlenbags, wooden box and shelves,bottl, plastic (Fg.5)

Fig.5 Simple material and technology required for mushroom production

Cultural

- Mushroom feeding culture and awareness was very low in Ethiopia .But now society mushroom feeding habit and marketing is inceased
- During training radio and TV program covrage has got and online transmission about mushroom utilization (eg.Tigray TV,Harrer FM) and awareness raised
- Ethinomycology study and identification of Mushroom utilization gaps by researcher. For instance Traditional Knowledge on Mushroom Consumption Habits of Amhara Region in Four Selected Districts - Mecha, Fogera, Bahirdarzuria and Zege was documented.
- Mushroom dish preparation awarness are increased and different mushroom product are sold on the market(soup,makiato, tea,tooth cleaing, food suplement) Fig.6
- Preparing brochur and poster in 3 languges and disstributing infrmation for awarness raising.

Fig.6. Mushroom food preparation and eating ceremonies at Holeta and Adama University.

7. Challenges of Mushroom Cultivation and Utilization

- Lack of availability of good quality spawn and there is no spawn producing and distribution center.
- Mold, Bactria and pest contamination challenge
- All Producer awareness about microbiological knowledge and techniques
- Poor marketing facilities and lack of proper marketing channels
- Mushroom fruiting body short shelf life and Poor transport and storage facilities
- Lack of facilitated mushroom production training center
- Low mushroom feeding and marketing culture of the society
- Problems associated with post harvest handling, drying, pickling and canning

8. Sustainability

- Quality Spawn (seed) availability and seed access to society.Eg.Decha mushroom cultivation labratory was built(Fig.9).
- Institutionalizing Mushroom production. (Fig.8). Eg. Holeta agriculture biotechnology Institute
- Distributing spawned bag and fully colonized mushroom mycelia from one research center
- Promoting national mushroom day and Exhibition of mushroom product and mushroom farmer demonstration. Example Five mushroom producers were demonstrating their farm activities at the ^{2nd} national mushroom day(Fig.7).

Fig.7. Mushroom national day motto and exhibition of mushroom producer

Fig.8. Staeholder's discussion and meeting during institutionalizing of Mushroom

Fig.9. Bonga/Decha mushroom cultivation laboratory and stakeholder discussion to sustainability issue

9. Scale up

Mushrooms can offer several benefits Nutritional, Medicinal, Environmental, Ecological and Economical values. However Ethiopia consists of divers mushroom varity it is still underutilized and society feeding habit is still low. Through adapting globally known exotic mushroom and developing production protocol for Ethiopian wild mushroom, it is possible to assure consumption and utilization of mushroom. By providing training for spawn and mushroom cultivation methods for selected

community groups in all regions help to scale up the utilization. By promotting smallscale enterprunuers working on mushroom processing and mushroom dish as well strengthing market link. Through establishing mushroom quality spawn producing center in different region and distributing to grassroot level itis possible to scaleup mushroom utiization. Certified and proffessional training center has to opened and demonstration site has to be prepared.

10. Reference

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