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FOSTERING FOOD SECURITY IN COMMUNITIES THROUGH THE PRODUCTION OF EDIBLE MUSHROOMS

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Abstract: Food security is one of the most important challenges facing nations, as communities suffering from poverty, environmental degradation, and limited access to nutritious food are the most vulnerable. That is why the production and commercialization of edible mushrooms is emerging as an alternative solution to this problem, as they are a sustainable, accessible, and nutritious natural product. This paper explores the potential of edible mushrooms as a food with nutritional qualities to strengthen food security programs in rural and urban communities. It also addresses nutritional, technological, and social aspects of their production, as well as successful experiences in Latin America. The implementation of community mushroom cultivation not only improves food availability but also promotes local development, environmental education, and economic resilience in marginalized communities.

Keywords: Food security, edible mushrooms, community.

Introduction

Currently, millions of people around the world lack access to food due to various factors such as economic, health, and environmental crises, among others. This has led to the need to seek innovative, sustainable, and accessible solutions that guarantee the right to food, mainly in marginalized communities. That is why one proposal to address this situation is food security, defined as physical, social, and economic access to sufficient safe and nutritious food to meet dietary needs as a fundamental human right (Food and Agriculture Organization of the United Nations [FAO], 2022) .

This encourages people in low-income communities to produce edible mushrooms and gain interest as a feasible alternative to promote food security. These organisms belong to the Fungi kingdom and are valued by people in various parts of the world for their ability to be cultivated in diverse spaces and climates, their high nutritional value, and their ability to use agricultural waste as a suitable substrate for small-scale production in community contexts.

The present work aims to disseminate the role that edible mushrooms can play in improving food security, highlighting their nutritional and economic benefits and presenting strategies for their cultivation in communities.

Edible mushrooms: an alternative for food security

Edible mushrooms are a valuable source of food due to their nutritional composition and versatility in production. Currently, there are several species of edible mushrooms that can be easily cultivated due to their domestication. Among the best known are *Pleurotus ostreatus* (oyster mushroom), *Agaricus bisporus* (button mushroom), and *Lentinula edodes* (shiitake) (Mafe, et al., 2025) . From a nutritional point of view, these mushrooms contain high levels of protein, B vitamins, minerals such as potassium, phosphorus, selenium, and zinc, as well as bioactive compounds with antioxidant and immunostimulatory properties (Valverde, Hernández-Pérez, & Paredes-López, 2015) . Compared to various animal products, mushrooms are low in calories and fat, making them a healthy option for the population and thus reducing the risk of cardiovascular or metabolic diseases (Cerón-Guevara, et al., 2020) .

On the other hand, edible mushrooms can be easily cultivated on organic waste such as wheat straw, sugarcane bagasse, sawdust, coffee husks, and other agro-industrial by-products, thus contributing to waste reduction and promoting the circular economy (Sánchez, 2010) . In this way, agricultural communities can transform their waste into high-value food and thus close production cycles with a significant reduction in environmental impact. In addition, some edible fungi have recognized medicinal properties, as they have been shown to contain compounds that strengthen the immune system, reduce cholesterol, and have antitumor activity, adding value to their consumption (Lindequist, Niedermeyer, & Jülich, 2005) . This leads us to consider edible mushrooms as part of a food that can have a significant impact on food security.

Impact on food security with edible mushrooms

Food security has four important pillars, which are the availability, access, consumption, and biological utilization of food (Garcia da Costa & Valdivia Romero, 2024) , as detailed in Table 1 below.

Therefore, the production of edible mushrooms by communities can directly contribute to the four important pillars of food security according to the FAO, which are availability, access, utilization, and stability (FAO, IFAD, WHO, WFP, UNICEF, 2021) . The first pillar, availability, would be achieved because edible mushrooms grow in a period of 15 to 40 days and can be produced all year round due to their domestication in small spaces, which would allow for

Food availability	Access to food	Food consumption	Biological utilization of food
This is when food is available at any time, without shortage due to lack of money or production.	This is when you have money to buy food or other things that cannot be produced but must be consumed.	This is when we eat certain foods that we choose according to customs, tastes, or preferences.	This is when food is used because the body needs it for energy to carry out daily activities.

Table 1. The four pillars of food security.

a continuous supply of the product. Unlike traditional agricultural products, their production does not depend on large tracts of land or specific climatic conditions, making cultivation viable even in urban areas or on degraded land.

Access, the second pillar, would be achieved because edible mushrooms can be produced locally and at low cost, and can be part of the daily diet without requiring large investments. This is relevant in communities where economic access limits the purchase of nutritious foods. The next pillar is consumption, which is involved because mushrooms provide essential nutrients, as well as a variety of culinary dishes or culinary versatility, which facilitates their integration into different food preparations and can be part of school or community feeding programs to promote healthy eating habits.

Finally, the fourth pillar refers to utilization, meaning that this type of food can be cultivated continuously and with low risk of loss, as it represents a stable food source over time, since it can be preserved by drying or pickling, extending its shelf life. Therefore, the cultivation of edible mushrooms in vulnerable communities is not only a food strategy, but can also be a tool for social empowerment and resilience in the face of food or economic crises, making it essential to take into account cultivation technologies and methods.

Community edible mushroom cultivation methods and technology

As mentioned above, the production of edible mushrooms is very easy, which is a great advantage because it does not require sophisticated technologies or costly investments, allowing for its adoption in rural or urban communities, even in marginalized areas or those with limited resources. Therefore, the fundamental aspects for the implementation of edible mushroom cultivation in communities are described below.

In community projects, the first step is to select the type of edible mushroom to be cultivated. The most recommended are *Pleurotus ostreatus* (oyster mushroom) due to their rapid growth, resistance, and good yield at low cost. Another mushroom is *Agaricus bisporus* (button mushroom) because it is the best known and most accepted by consumers in the market, and *Lentinulas edodes* (shiitake) because it has high nutritional value and medicinal properties, although it may require a more careful and costly process (Martínez Barcenas, 2019) .

Once the type of mushroom has been selected, the next parameter to consider is the substrate available in the area in order to reduce transportation costs from one location to another as well as promoting sustainability and low-cost production. Some substrates used for the production of edible mushrooms include wheat and rice straw, sugarcane bagasse, softwood sawdust, coffee or cocoa husks, corn husks, and banana peels, among others. This will promote the use of waste and prevent it from becoming waste, in addition to reducing the environmental impact and thereby transforming waste into useful resources in the life cycle of the raw material (Grodzínskaya, Diógenes Infante, & Piven, 2002; Gaytan-Hernández, Salmones, Pérez Merlo, & Mata, 2006) . On the other hand, the cultivation process is carried out once the edible mushroom and the substrate to be used have been selected, taking into account the stages shown in Table 2.

Edible mushrooms can be grown in simple spaces, such as conditioned rooms, rustic greenhouses, roofs, garages, or vertical systems in urban areas. Finally, the community must organize itself to take training courses with practical workshops, and there must be technical support from experts in the field to create cooperatives or work teams that strengthen sustainability. They must also strengthen the participation of women and young people to ensure greater social impact and continuity of the project over time. This will promote social, economic, and environmental benefits.

Economic, social, and environmental benefits from mushroom cultivation

The production of edible mushrooms in community crops not only generates food security, but also various benefits such as income generation, which focuses on obtaining extra profits from the sale of products in local markets, agricultural fairs, or restaurants to increase demand and nutritional value, since mushrooms can be an important source of capital for low-income or marginalized families and communities. In addition, mushroom derivatives such as dehydrated mushrooms, preserves, sauces, pâtés, and food supplements, among other products, can be made, thereby increasing their added value and diversifying sources of income (Mayett & Martínez-Carrera, 2010) .

Another benefit is social inclusion, as it allows for the participation of diverse social groups because it is considered an inclusive activity involving women, children, older adults, and people with disabilities, since the activities do not require excessive physical strength or long distances, in addition to promoting collaborative work and thus strengthening the social fabric through community networks and production cooperatives. Environmental education and recycling is a benefit in which organic waste is used for the production of edible mushrooms, promoting sustainable practices, teaching recycling, and respect for natural cycles, which has important educational value in communities and schools.

Mushroom cultivation also promotes environmental conservation, as compared to agricultural or livestock production, this activity consumes less water, does not re-

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Stage	Characteristics
Substrate preparation	This stage includes cleaning, hydration, and pasteurization to prevent contamination with other microorganisms (fungi, bacteria, etc.) that could have adverse effects on the crop.
Inoculation	The fungus must first be grown on seeds (sorghum, oats, wheat, etc.) to generate mycelium, and then the mycelium (vegetative structure) is sown on the substrate.
Incubation	In this phase, the fungal mycelium colonizes the substrate, where the environmental conditions are darkness in the cultivation room, controlled humidity of approximately 75%, and a temperature at which the edible fungus develops between 24 and 25°C.
Fruiting	The edible fungus in the form of mycelium begins to colonize the substrate, forming fruiting bodies. At this stage, greater ventilation, diffuse light of less than 20%, a temperature between 20 and 30°C, and controlled humidity of 80% are required.
Harvest	This last stage can be carried out several times, i.e., two to three cuts are made before the substrate is exhausted by the fungus.

(Grassi & Restell, 2019; Montenegro & Stuardo, 2021)

Table 2. Stages of the edible mushroom cultivation process.

quire chemical fertilizers or pesticides, and makes use of small spaces, thus contributing to clean and ecological production. This has shown that food security through edible mushrooms is a viable option, as there are several success stories in Latin America.

Success stories

Community projects based on edible mushrooms have demonstrated the transformation of communities, income generation, reduction of food insecurity, and the promotion of sustainability, as is the case in Mexico in the communities of Shihochac and Santo Domingo de Késte in Champotón, Campeche, where three types of sausages and two jams were made from edible mushrooms. which were evaluated by the people of these communities. The results showed that the by-products were accepted by the people, obtaining good acceptability values in terms of smell, color, taste, and appearance. Therefore, there was no negative impact, and it was an alternative for consumption and commercialization to provide nutritious, good-quality products to families in rural areas, as well as a source of extra income for families (De la Cruz-Blanco, Morán-Arellanos, Huicab-Pech, & Rosales-Martínez, 2020) .

On the other hand, a group of Mixe women from the indigenous community of Santa María Tlhuitoltepec in the Mixe Sierra of Oaxaca organized themselves to start producing *Pleurotus ostreatus* mushrooms as part of an economic empowerment and food sovereignty project, where they were supported by a local higher education institution and non-governmental organizations in which they learned to grow mushrooms using agricultural waste such as corn straw and coffee, which improved the local diet with this nutritious and accessible product and generated income through the sale of fresh and dehydrated mushrooms at regional fairs; It also strengthened women's participation in community decision-making,

serving as a model that could be replicated in other regions of Mexico or Latin America (Cruz, Martínez, & Morales, 2021) .

In Latin America, community projects focused on food security with mushrooms have also been developed. For example, the National Learning Service (SENA) through the department of Cauca promoted projects in some regions of Colombia that were affected by armed conflicts, which focused on the production of edible mushrooms as a strategy for social and economic reconstruction. In other words, it trained farmers displaced by violence in the cultivation of *Pleurotus ostreatus* using sugarcane waste as a productive alternative. The results showed food security and new economic opportunities without the need for large tracts of land or costly inputs (National Learning Service [SENA], 2022) .

Other communities that benefited were in the popular urban areas of Lima, Peru, where residents of Villa El Salvador implemented urban agriculture projects that included the cultivation of edible mushrooms in spaces such as rooftops or patios using simple techniques and recycled materials to produce *Agaricus bisporus* or *Pleurotus ostreatus* for family consumption and sale in neighborhood markets. These projects were supported by universities and environmental groups, and the results showed that edible mushroom cultivation can also be an important tool in urban environments where access to fresh food is limited (Vásquez & Romero, 2020) . These cases show that training, community organization, and technical support in edible mushroom cultivation can be adapted to different environments and contribute to the well-being of families at the local level and, above all, to food security. Although there are success stories that demonstrate the benefits of edible mushroom cultivation, there are also challenges that must be addressed in order to achieve sustainable and expanding food security.

Challenges of edible mushroom cultivation for food security

During the process of cultivating edible mushrooms, there are also obstacles that must be addressed and resolved, or at least minimized, in order to achieve food security in communities. Table 3 below presents some of the challenges and opportunities.

The risks will be overcome once a comprehensive approach is adopted that takes into account a combination of technical knowledge, social support, and political will. This will consolidate the cultivation of edible mushrooms as an important tool that will endure to transform communities and make food security a reality.

Conclusions

The cultivation of edible mushrooms currently represents an innovative, accessible, and sustainable strategy for improving food security in the most vulnerable rural and urban families and communities, due to its various advantages such as nutritional value, ease of cultivation, use of waste, low cost, and climate adaptability. Mushrooms have the potential to become an important pillar of food sovereignty and local development. They are also foods that provide humans with protein and micronutrients. In addition, they promote economic benefits, social inclusion, and contribute to the environment.

Risks	
Lack of technical knowledge	Many communities are unaware of the stages involved in mushroom cultivation, which limits productivity and leads to frustration if initial attempts at cultivation are unsuccessful.
Limited access to inputs	Some inputs, such as mycelium (mushroom seed), are not available locally or are very expensive in areas where communities have low economic resources, or rural regions may have difficulty obtaining the appropriate materials due to distance.
Limited or unstable market	Producers may have good harvests but face marketing constraints such as lack of sales, consumer unfamiliarity with the product, or low prices due to product distribution in the market.
Inadequate climatic and sanitary conditions	Lack of control over growing conditions such as temperature, humidity, and ventilation to achieve optimal growth in fruiting.
Poor institutional coordination	Lack of ongoing support from government or educational institutions, leading to the abandonment of the project.
Opportunities	
Continuous training and technical support	Develop accessible training programs adapted to local realities, for which educational institutions can play an important role in organizing workshops, practical training, and remote technical support to answer questions during the cultivation process.
Creation of community mycelium banks	Establish spaces within the community that produce and distribute low-cost mycelium so that the supply is constant and reliable and does not depend on external suppliers.
Promotion of short marketing circuits	Promote direct sales in local markets, agricultural fairs, local restaurants, or via the internet so that producers obtain greater economic benefits and thus bring fresh and healthy products closer to consumers.
Institutional support and public policies	Governments at all levels should adopt these types of proposals as a strategy for food security, social economy, and community sustainability, including financing programs, technical assistance, clear regulations, and educational campaigns.
Consumer awareness	Promote campaigns for the consumption of edible mushrooms based on their nutritional benefits, recipes, cooking workshops, and community outreach to increase demand and provide an incentive to continue production.

Table 3. Risks and opportunities for food security through edible mushrooms

There are currently many success stories in Latin America that demonstrate community organization, technical training, and institutional support, which make it possible to transform realities through this activity.

However, in order to scale up and consolidate these projects, it is necessary to overcome challenges related to training, access to inputs, marketing, and inter-institutional coordination. Therefore, it is recommended to promote public policies that integrate mushroom production into the agendas of food security, environmental education, and social economy.

In times of climate crisis, inequality, and rapid urbanization, edible mushrooms offer not only food but also hope and autonomy for thousands of people. Therefore, growing mushrooms is, in essence, cultivating life, knowledge, and community resilience.

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