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Student-led agribusiness innovation: Organic oyster mushroom production and marketing in Cape Coast, Ghana

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Abstract

The health benefits of mushrooms have led to a steady increase in demand across households in Ghana. However, limited production capacity has created a gap between demand and supply, forcing many restaurants and guesthouses to remove mushrooms from their menus. This study addresses that gap through the establishment of Trinity Mushroom Enterprise, focused on the organic production and processing of oyster mushrooms at the University of Cape Coast. The enterprise employed innovative marketing strategies including door-to-door sales, social media promotion, and word-of-mouth advertising to reach target customers. While the study proved as a successful agribusiness venture, challenges such as structural defects, pest outbreaks, and inadequate shelving reduced overall output. Recommendations include structural improvements like insulated greenhouses and better incubation-cropping separation. This study reveals that organic mushroom farming holds great promise as a viable and profitable venture in Ghana, thriving when supported by the right environmental practices and market access.

Keywords: Oyster Mushroom; Organic Farming; Mushroom Processing; Agribusiness; Value Addition; Cape Coast

1. Introduction

Mushrooms are edible fungi with substantial nutritional and medicinal value. Historically, the term “mushroom” was derived from the French word mousseron, referring to fungi and molds. Mushroom cultivation began as early as the 1600s when a Parisian melon farmer discovered mushrooms growing in his compost, laying the foundation for commercial production [1].

Unlike conventional crops, mushrooms do not produce seeds and therefore require biotechnological support for cultivation. Processing methods such as canning or polythene packaging are used to extend their short shelf life and ensure they reach distant markets [2,3].

Globally, oyster mushrooms (Pleurotus spp.) are among the most cultivated varieties due to their adaptability, minimal production cost, and ease of processing [4]. They are rich in amino acids, essential minerals, and easily digestible proteins, making them beneficial for children and individuals with weakened immune systems [5]. Mushroom farming has gained traction as a sustainable agribusiness model, especially in developing countries, due to its low space requirements, affordability, and ability to generate income for landless youth and unemployed graduates [6].

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In Ghana, mushroom production has witnessed steady growth, supported by favorable climatic conditions, abundant agricultural waste for substrates, and increasing demand for healthier food options. The introduction of projects like the European Union's Adentan Mushroom Initiative, aimed at creating over 5,000 jobs, reflects the national effort to integrate mushrooms into the local economy [7, 9].

The high perishability of mushrooms necessitates value addition techniques to reduce post-harvest losses. These include drying, powdering, and pickling, which not only enhance shelf life but also diversify product offerings [8].

Recognizing these opportunities and challenges, Trinity Mushroom Enterprise was established at the University of Cape Coast Technology Village. The enterprise is a partnership between three final-year students — Asamoah Oppong Zadok, Odurowaa Nketia Mary, and Adu Boahen Mabel — under a Supervised Agribusiness Project (SAP). The enterprise specializes in organic oyster mushroom production and processing, targeting key consumers such as students, lecturers, hospital patients, and restaurants.

This study aim to establish and assess the feasibility, sustainability, and market potential of a student-led organic oyster mushroom agribusiness—Trinity Mushroom Enterprise—focused on the production, processing, and marketing of high-quality mushrooms at the University of Cape Coast and its surrounding areas, with the aim of addressing supply shortages, promoting healthy food alternatives, creating employment, and enhancing local agribusiness development through innovative, availability of local raw materials, eco-friendly, and market-driven practices.

2. Materials and Methods

2.1. Study Location and Facility Layout

Trinity Mushroom Enterprise was situated at the Technology Village of the University of Cape Coast, a location selected for its favorable climatic conditions and proximity to key markets and raw materials. The production facility comprised two primary areas: an incubation room and a cropping house, each measuring 12.5 meters by 15 meters. This spatial configuration supported the sequential nature of mushroom cultivation from incubation to harvesting.

2.2. Technical Feasibility

The selected site was evaluated and deemed appropriate based on criteria such as hygiene, ventilation, and moisture retention. The design incorporated plastic sheeting to seal structural gaps, preventing pest intrusion and helping maintain optimal humidity. The team had prior training in mushroom cultivation and agribusiness, which contributed to efficient implementation of technical procedures.

2.3. Production Inputs and Equipment

The enterprise utilized readily available local materials and basic equipment. Key inputs included sawdust, wheat bran, quicklime, wood shavings, water, disinfectants, polypropylene bags, rubber bands, PVC pipes, and foam corks. Essential equipment consisted of metal drums, gas stoves, weighing scales, shelves, and knapsack sprayers. The affordability and accessibility of these items contributed to the sustainability of the project within a student-led agribusiness context.

2.4. Cultivation Process

The cultivation process began with substrate preparation, where sawdust, wheat bran, quicklime, wood shavings, and water were thoroughly mixed and allowed to ferment. The mixture was then packed into polypropylene bags, sealed using PVC pipes, foam corks, and rubber bands. Sterilization followed, using heat generated from gas stoves and firewood to eliminate potential contaminants.

Post-sterilization, the bags were cooled and inoculated with mushroom spawns under sterile conditions. The inoculated bags were placed in the incubation room, where they were kept in darkness at 28–30°C for 4–6 weeks to allow full colonization by the mycelium. Once colonized, the bags were transferred to the cropping room, where light and humidity stimulated mushroom growth. Harvesting occurred within 3–4 days of fruiting by twisting the stem near the substrate.

Figure 1 Trinity Mushroom Production Cycle: From Preparation to Packaging

2.5. Post-Harvest Processing

Fresh mushrooms were stored at temperatures between 5°C and 8°C to preserve quality. Surplus or lower-grade mushrooms were dried under sunlight and milled into powder for extended shelf life. The dried and powdered mushrooms were packaged in airtight bags for sale.

Figure 2 Packaged dried and powdered mushroom

2.6. Marketing and Distribution

Marketing strategies combined traditional and digital tools. Flyers, posters, social media (WhatsApp and Facebook), and word-of-mouth were used to reach potential customers. The enterprise adopted a skimming pricing strategy due to the premium nature of organic mushrooms. Bulk buyers received free delivery, while smaller orders incurred a modest transportation fee. Products were sold in 0.2 kg units, both fresh and processed, at competitive prices.

2.7. Financial Planning

Initial projections estimated annual revenue of approximately USD 15,372.23 from 3,291 kg of fresh mushroom production. Start-up costs were estimated at USD 3,208.15, divided into variable (USD 1,011.20) and fixed (USD 2,196.95) expenses. A break-even analysis indicated that 696 units (equivalent to about USD 2,899.84 in sales) were required to recover initial investment. Funding was sourced entirely from partners' contributions.

3. Results and Discussion

3.1. Market Response and Sales Performance

During the implementation of the project, Trinity Mushroom Enterprise observed market dynamics that differed from initial projections. While initial target markets included students, lecturers, and local restaurants, the enterprise also penetrated new markets such as Takoradi, Interbeton, and the University of Cape Coast (UCC) Hospital. The school farm, which was not part of the original projections, became the highest-volume buyer of fresh mushrooms. Sales data revealed that institutional buyers had the highest demand for fresh oyster mushrooms, with the school farm purchasing 135 kg and UCC Hospital purchasing 101 kg. In contrast, student patronage remained low, likely due to limited culinary use among students. For the dried and powdered mushrooms, Tamale emerged as the top market, likely due to its distance from Cape Coast and the need for longer shelf life. Markets such as Accra and Takoradi were more interested in fresh mushrooms, while the farther northern regions appreciated dried forms due to limited refrigeration facilities.

3.2. Marketing Strategy Effectiveness

Marketing strategies that enhanced sales included word-of-mouth referrals from satisfied customers, which helped build trust and expand the customer base. Door-to-door delivery ensured timely product distribution, encouraging repeat purchases and improving customer satisfaction. Social media promotions on platforms such as WhatsApp and Facebook were effective in reaching a wider audience, aligning with modern trends in agribusiness marketing. Furthermore, the team participated in exhibitions and trade fairs and offered incentives such as loyalty discounts and cooking demonstrations to introduce unfamiliar mushroom products to potential buyers. Despite these efforts, several challenges limited the impact of marketing strategies. Many consumers were unfamiliar with cultivated oyster mushrooms and required extensive education on their health benefits. The high perishability of mushrooms meant that without immediate refrigeration or processing, they deteriorated quickly. Initial freezing led to quality loss, prompting the enterprise to explore alternative preservation strategies such as drying. Additionally, balancing academics with business operations limited the partners' ability to market products consistently. The cost of promotional materials like posters and social media ads also strained the enterprise's limited financial resources.

3.3. Financial Outcomes

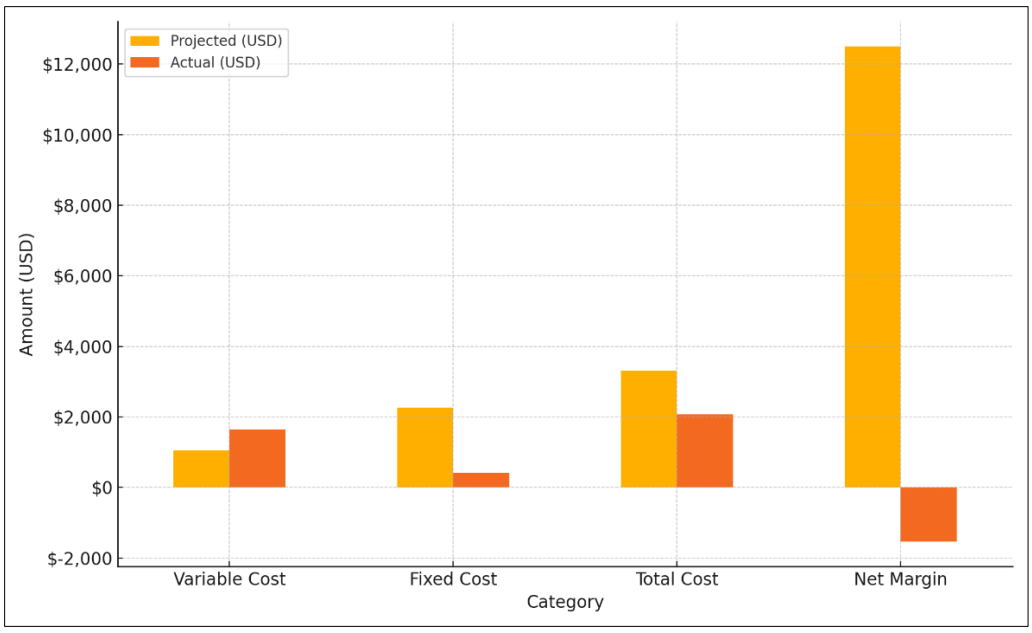

Figure 3 Projected vs. Actual Costs and Net Margin (USD)

Financial analysis revealed that the enterprise incurred a total start-up cost of approximately USD 2,029.73, which was lower than the projected USD 3,208.15 due to the implementation of only one production cycle. However, the actual variable cost of about USD 1,605.34 exceeded the projected USD 1,011.20 due to additional unplanned expenses, including higher-than-expected costs for spawn, labor, and packaging. Sales revenue over 2.5 months totaled approximately USD 524.44 from both fresh and powdered mushrooms, falling short of the break-even target of around USD 892.13. Consequently, the business recorded a negative gross margin of about USD 1,080.90 and a net loss of

roughly USD 1,494.13. Monthly sales for fresh mushrooms peaked in February at around USD 203.72, reflecting growing customer awareness and repeat purchases, but declined sharply in April due to decreased yields and market saturation. These financial trends are illustrated in Figures 3 and 4, which compare projected and actual costs, as well as break-even points and revenue.

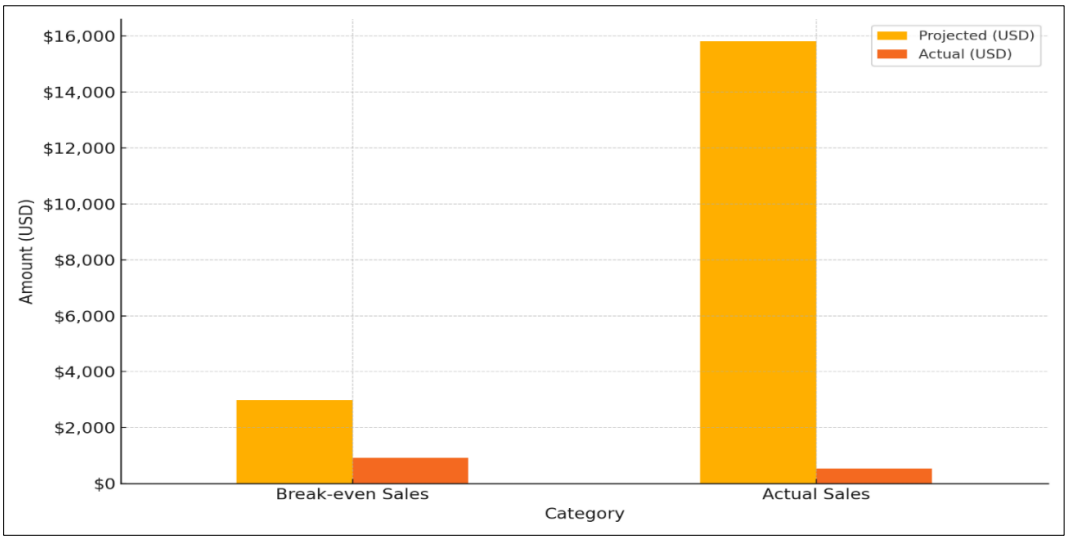

Figure 4 Projected vs. Actual BEP and Sales (USD)

Figure 5 visually distinguishes between fresh and powdered mushroom sales, highlighting the relative market demand for each product type. Sales for dried mushrooms were highest in March at approximately USD 14.95, coinciding with increased investments in value addition. This analysis indicates that while the enterprise was operationally feasible, strategic financial planning and reinvestment were critical areas needing improvement.

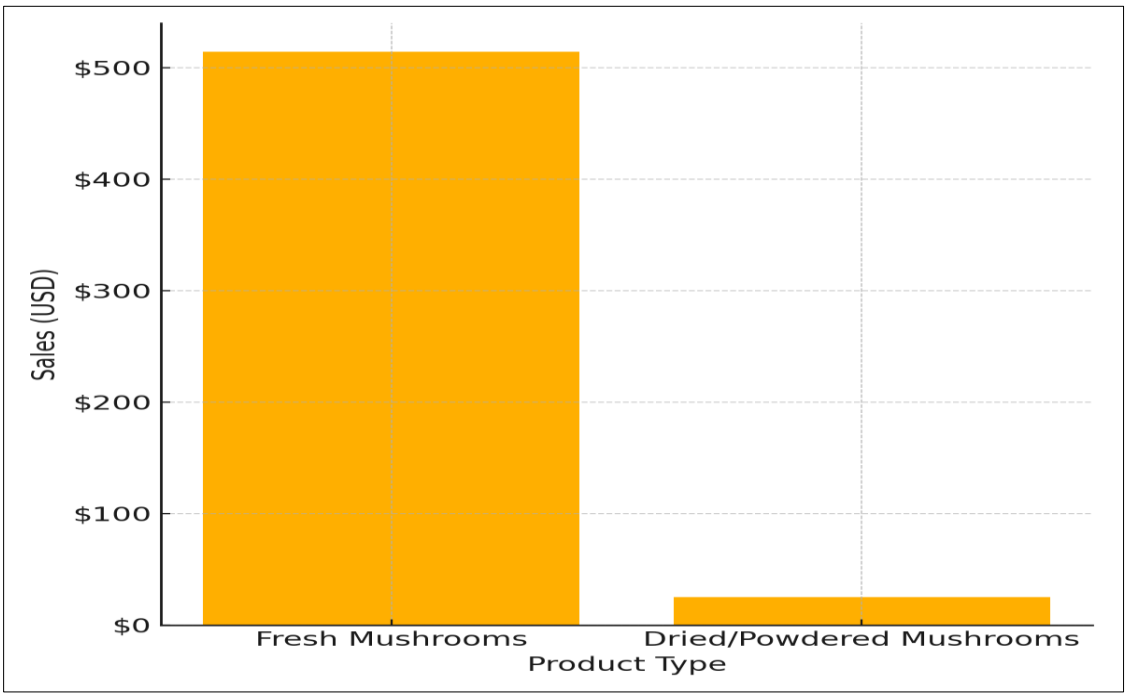

Figure 5 Fresh vs. Dried/Powdered Sales

3.4. Operational Constraints

The project faced several operational challenges that impacted its overall success. Structural delays and idle time after orientation hindered the ability to complete the intended two production cycles. Pest and disease outbreaks,

particularly green mold and ink caps, compromised the integrity of substrate bags, leading to contamination and significant yield losses. Adhering to organic practices, the enterprise refrained from using synthetic fungicides, opting instead to discard contaminated bags to prevent further spread. Structural deficiencies, such as leaks in the roofing system and open bamboo poles, allowed excess moisture and pests to enter, further reducing the quality and yield of the mushroom bags. The incubation and cropping rooms also suffered from inadequate racks and shelves, necessitating the placement of substrate bags on the floor, a practice known to increase contamination risks. Additionally, improper workflow sequencing, such as sterilizing substrate bags before spawn acquisition, resulted in production delays and higher contamination rates. These operational constraints underscored the importance of proactive planning, strict hygiene standards, and investment in durable, well-designed infrastructure for successful mushroom agribusinesses.

4. Conclusion

The Trinity Mushroom Enterprise demonstrated the practical viability of small-scale, student-led agribusiness ventures focused on non-traditional crops such as oyster mushrooms. Throughout the six-month project cycle, the enterprise encountered key lessons in production, processing, and marketing that will be instrumental in shaping future agribusiness models. Although the project experienced constraints related to structural delays, pest infestations, and inadequate infrastructure, it managed to achieve notable milestones in sales, market penetration, and product innovation.

A key takeaway from the project was the vital importance of hygiene and sanitation during the sterilization and incubation phases, which directly impacted contamination rates and yield consistency. Effective workflow planning and timely input procurement emerged as crucial for maintaining operational efficiency. The project also emphasized the need for product diversification to meet consumer demands, processing mushrooms into dried and powdered forms not only extended their shelf life but also enhanced their market appeal. On the marketing front, personalized approaches such as door-to-door delivery, social media engagement, and customer loyalty incentives proved highly successful in boosting sales. Nonetheless, limited time for daily marketing due to academic obligations and low public awareness of cultivated mushrooms posed significant challenges to scaling up operations.

Moving forward, it is recommended that future mushroom enterprises invest in durable, insulated greenhouses to ensure year-round production and minimize losses due to environmental fluctuations. The cropping and incubation areas should be clearly separated to prevent premature exposure of uncolonized substrate bags to light, and additional shelving should be provided to avoid placing bags directly on the floor. These infrastructural upgrades will reduce contamination risks and improve production efficiency.

Entrepreneurs should also adopt a proactive planning approach, ensuring all materials and inputs are secured ahead of each production phase. The project further underlined the value of continuous learning and flexibility, as the team adapted their techniques and strategies in response to real-time challenges. By combining hands-on production with innovative marketing and efficient cost management, student entrepreneurs can successfully navigate the agribusiness landscape while addressing food security and employment challenges in their communities.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare no conflict of interest regarding the publication of this manuscript.

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