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A comparative study of enzymatic activity in fresh and dehydrated *Pleurotus florida*

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Abstract
Oyster mushrooms (*Pleurotus florida*) are well-regarded for their rich nutritional profile and bioactive compounds, making them a valuable dietary resource. This study investigates the enzymatic activity in fresh and dehydrated *Pleurotus florida*, focusing on key enzymes such as protease, cellulase, and laccase. Fresh mushrooms exhibited higher enzymatic activity compared to their dehydrated counterparts, underscoring the impact of dehydration on enzyme functionality. These findings provide insights into the potential use of *Pleurotus florida* in food processing and biotechnology applications.

Keywords: Oyster mushrooms, *Pleurotus florida*, enzymatic activity, dehydration, protease, cellulase, laccase

Introduction
Mushrooms, particularly those of the genus *Pleurotus*, have gained recognition for their nutritional and therapeutic benefits. *Pleurotus florida*, a commonly cultivated oyster mushroom, is a rich source of proteins, vitamins, minerals, and bioactive compounds. Enzymes like protease, cellulase, and laccase, found in *Pleurotus florida*, play significant roles in biological processes, including nutrient breakdown and lignocellulose degradation. Understanding how dehydration affects enzymatic activity is critical for optimizing their use in food preservation, biotechnology, and pharmaceuticals.
This study aims to compare the enzymatic activity of fresh and dehydrated *Pleurotus florida*, providing insights into the influence of dehydration on enzyme functionality and its implications for industrial applications.

Materials and Methods
- **Sample Collection:** Fresh *Pleurotus florida* mushrooms were procured from a local farm and divided into two groups. One group was used immediately for fresh enzymatic analysis, while the other was dehydrated using a hot air oven at 50°C for 12 hours.
- **Enzyme Extraction:** Enzyme extracts were prepared from both fresh and dehydrated mushrooms by homogenizing 10 g of each sample in 50 mL of phosphate buffer (pH 7.0) and centrifuging the mixture at 10,000 rpm for 15 minutes. The supernatant was used for enzymatic assays.

Enzymatic Assays
- **Protease Activity:** Casein was used as the substrate, and absorbance was measured at 280 nm after incubation.
- **Cellulase Activity:** CMC was the substrate, and reducing sugars were quantified using the DNS method.
- **Laccase Activity:** ABTS served as the substrate, with absorbance recorded at 420 nm.

Statistical Analysis: Results are presented as mean±standard deviation, analyzed using one-way ANOVA with a significance level of $p < 0.05$.

3. Results

Table 1: Enzymatic Activity in Fresh and Dehydrated *Pleurotus florida*

Enzyme	Fresh Sample (U/mL)	Dehydrated Sample (U/mL)	% Reduction in Activity
Protease	3.5±0.1	1.8±0.2	48.6%
Cellulase	2.8±0.2	1.4±0.1	50.0%
Laccase	1.2±0.1	0.6±0.1	50.0%

Protease Activity: The protease activity in fresh *Pleurotus florida* was significantly higher (3.5±0.1 U/mL) than in dehydrated samples (1.8±0.2 U/mL). The nearly 50% reduction is attributed to thermal denaturation during dehydration. Protease enzymes, essential for protein hydrolysis, are highly sensitive to heat, which disrupts their tertiary structure.

Cellulase Activity: Cellulase activity also showed a marked decline from 2.8±0.2 U/mL in fresh samples to 1.4±0.1 U/mL in dehydrated samples, indicating a 50% reduction. Dehydration affects the stability of cellulases, enzymes critical for lignocellulosic biomass degradation, potentially limiting their efficiency in industrial applications.

Laccase Activity: Laccase activity experienced a similar reduction, declining by 50%. The enzyme's sensitivity to oxidative stress and heat during dehydration compromises its activity. Laccases are pivotal in bioremediation and polymer synthesis, making their stability a key factor in industrial use

Discussion

The findings of this study reveal a significant reduction in enzymatic activity in *Pleurotus florida* mushrooms upon dehydration. Fresh samples demonstrated superior protease, cellulase, and laccase activities compared to their dehydrated counterparts. This difference underscores the sensitivity of these enzymes to the processing conditions involved in dehydration, particularly thermal exposure and prolonged oxygen contact. Protease activity showed a pronounced decrease in the dehydrated samples, indicating that high temperatures disrupt the structural integrity of the enzyme. Proteases, being proteinaceous in nature, are highly susceptible to denaturation when exposed to heat, which alters their active sites and reduces catalytic efficiency. This loss is particularly concerning for applications in the food industry where protease activity is critical for protein hydrolysis, tenderization, and flavor enhancement. The study reinforces the need for milder dehydration methods to preserve these functionalities in oyster mushrooms intended for industrial use.

Cellulase activity also experienced a considerable decline after dehydration. As cellulases are primarily involved in breaking down cellulose into simpler sugars, their activity is vital for industries such as biofuel production, paper manufacturing, and food processing. The thermal instability of cellulases observed in this study highlights the limitations of hot air drying as a preservation technique for enzymatically active mushroom products. This suggests that alternative drying methods, such as freeze-drying, could be explored to maintain cellulase activity without compromising the structural integrity of the enzyme. Furthermore, the loss of cellulase activity may hinder the use of dehydrated mushrooms in applications that depend on their ability to degrade plant-based substrates, particularly in biotechnological processes. Laccase, a key oxidative enzyme involved in lignin degradation and bioremediation, also exhibited a marked reduction in activity in the dehydrated samples. This enzyme's sensitivity to both thermal and oxidative stress during the drying process likely accounts for its diminished functionality. The decrease in laccase activity not only limits its potential in industrial applications but also reduces the antioxidant properties of the dehydrated mushrooms, which are often sought after in nutraceutical and health-related products. Given the increasing interest in sustainable practices, the reduced laccase activity poses a challenge for industries relying on mushrooms as a source of natural enzymes for environmental remediation and green chemistry. The overall results of this study emphasize the detrimental effects of dehydration on enzyme stability in *Pleurotus florida*. While dehydration extends shelf life and facilitates storage and transport, it significantly compromises the enzymatic properties that are critical for both nutritional value and industrial applications. This trade-off suggests a pressing need to optimize processing conditions to balance preservation and enzyme retention. Innovations in dehydration technology, such as vacuum drying or the addition of enzyme stabilizers during the drying process, could potentially address this issue. Stabilizers like sugars and polyols have been shown to protect enzyme structures by preventing denaturation and maintaining hydration around the protein molecules during thermal stress.

This study also raises questions about the broader implications of enzyme loss in dehydrated mushrooms. Beyond industrial applications, the reduction in enzymatic activity could affect the digestibility and bioavailability of nutrients in mushrooms when consumed. Enzymes like protease and cellulase play a role in breaking down complex molecules into absorbable forms, and their reduction may influence the nutritional efficacy of dehydrated products. This warrants further investigation into the impact of enzymatic activity loss on the functional food properties of mushrooms, particularly in the context of dietary health and wellness. In conclusion, the findings of this study provide a foundation for understanding the enzymatic dynamics of *Pleurotus florida* under dehydration. While the results highlight the limitations of hot air drying, they also pave the way for exploring alternative preservation strategies that retain enzymatic activity, thus enhancing the utility of mushrooms in both nutritional and industrial contexts. Future research could delve deeper into the molecular mechanisms underlying enzyme denaturation during dehydration, as well as evaluate the effectiveness of novel processing technologies in mitigating these effects. This would ensure that the full potential of oyster mushrooms as a source of bioactive enzymes is harnessed in diverse applications.

Conclusion

This study demonstrates the significant impact of dehydration on the enzymatic activity of *Pleurotus florida*, with fresh mushrooms exhibiting markedly higher levels of protease, cellulase, and laccase activities compared to their dehydrated counterparts. The findings underscore the

sensitivity of these enzymes to thermal and oxidative stresses encountered during the dehydration process, which compromises their catalytic efficiency and limits their potential applications in food processing, biotechnology, and other industrial sectors. The reduction in enzymatic activity also highlights a trade-off between extending shelf life through dehydration and preserving the bioactive properties of the mushrooms. While dehydration facilitates storage and transport, it diminishes the functional attributes that are essential for various applications. This study advocates for the exploration of alternative drying methods, such as freeze-drying or vacuum drying, and the incorporation of enzyme stabilizers to mitigate the adverse effects of dehydration. The study also raises important questions regarding the nutritional and functional implications of enzyme loss in dehydrated mushroom products, particularly in terms of digestibility and nutrient bioavailability. These findings serve as a basis for further research aimed at optimizing processing techniques to retain the enzymatic integrity of *Pleurotus florida*, ensuring its utility as a functional food ingredient and a source of industrially relevant enzymes. By balancing preservation methods and enzymatic stability, the full potential of oyster mushrooms can be harnessed in diverse scientific and commercial applications.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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