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Mushroom Production Using Banana Leaves, Rice Straw, and Cogon in Urban and Rural Negros Oriental

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Abstract. This study investigated the effectiveness of three substrates—dried rice straw, dried banana leaves, and dried cogon leaves—in optimizing mushroom yield under varying environmental conditions. The need for food self-sufficiency was never a genuine concern when the pandemic hit, highlighting the importance of producing food in one's yard. Mushrooms, particularly Volvariella volvacea, represent a viable option. Dried rice straw is an effective and eco-friendly substrate for mushroom cultivation, especially in rice-producing regions. Its high cellulose, hemicellulose, and lignin content provide essential nutrients, making it well-suited for mushroom production. Dried banana leaves are a practical and sustainable substrate option for mushroom cultivation, particularly in tropical regions where bananas are widely grown. Like dried rice straws, they also contain cellulose and lignin. Cogon grass, an invasive plant in many regions, is increasingly used as a mushroom substrate due to its abundance, low cost, and lignocellulosic content. Rich in cellulose and hemicellulose, it provides essential nutrients for mushroom production. Farmers from selected urban and rural areas participated in the study, cultivating mushrooms using the three substrates. Data were analyzed using Analysis of Variance (ANOVA) and Duncan's Multiple Range Test (DMRT) at the 5% and 1% significance levels. The result indicated no significant differences in yield among the three substrates at either significance level. However, dried rice straw consistently yielded the highest total and mean outputs, followed by dried banana leaves, while dried cogon leaves produced the least. This trend was observed across all locations and environmental conditions. The results suggest that rice straw is the most effective substrate for Volvariella volvacea cultivation. Given its consistent performance across various conditions, rice straw is recommended for farmers aiming to optimize mushroom yields. Future research should explore optimizing substrate combinations, supplementations, and refining cultivation techniques to enhance production, ensuring the continued development of mushroom cultivation practices.

Keywords: Food production; Mushroom cultivation; rice straw substrate; Substrate decomposition; Sustainable food production; Volvariella volvacea.

1.0 Introduction

Mushroom cultivation has emerged as a sustainable agricultural practice that transforms low-value agricultural and forestry by-products into nutritious food, addressing global food security challenges. Substrates such as rice straw, banana leaves, and cogon grass are viable alternatives for mushroom farming, particularly for saprophytic species like *Volvariella volvacea*. These substrates, rich in cellulose, hemicellulose, and lignin, support fungal growth while contributing to circular agriculture by reducing agricultural waste (Hu et al., 2023). Historically, China is recognized as the earliest country to cultivate mushrooms and ranks among the top producers today, alongside the United States, Italy, the Netherlands, and Poland.

The global demand for mushrooms has increased significantly, with production growing over 13.8-fold in the past three decades. This growth highlights the importance of integrating sustainable practices into mushroom farming to address environmental challenges and optimize yields (Royse et al., 2021; FAOSTAT, 2022). However, stagnation in production outside China underscores the need to adopt innovative cultivation methods and expand the use of alternative substrates. In the Philippines, *Pleurotus ostreatus* is cultivated commercially due to its feasibility for mass cultivation, and preservation methods such as canning extend its shelf life. *Volvariella volvacea*, another widely available species, flourishes particularly during thunderstorms.

Mushrooms are nutritionally, economically, and biotechnologically valuable. They are low in calories and high in protein and fiber. Beyond their nutritional value, mushrooms serve critical roles in the pharmaceutical industry, recognized for their antioxidant, anticancer, and immunomodulating properties (Niazi & Ghafoor, 2021). Traditional knowledge among indigenous peoples has highlighted the medicinal benefits of both edible and wild mushrooms, which are now being studied for their bioactivity against various ailments.

Mushrooms offer a significant and largely untapped resource for new pharmaceutical products, with various activities reported in areas such as antitumor, cardiovascular, and antimicrobial properties. In developing nations like India, mushroom cultivation can improve food security, healthcare, and employment opportunities. Their combination of umami flavor and high nutritional content makes mushrooms a cost-effective food source across many cultures. Additionally, mushrooms boast a diverse range of bioactive metabolites that can aid in preventing and treating health issues. Extracts from medicinal mushrooms have shown potential in wound healing through various mechanisms (Javad et al., 2020).

In light of increasing food scarcity and the challenges posed by the COVID-19 pandemic, mushrooms can play a crucial role in sustainable food production. However, the seasonal abundance of *Volvariella volvacea* poses sustainability challenges. To address this, spawn production in controlled conditions and the cultivation of mushrooms on diverse substrates is essential. Supporting the mushroom industry is vital for rural economic development. This study aims to help farmers in urban and rural areas produce quality, low-cost mushrooms, thereby contributing to food security and sustainability.

2.0 Methodology

2.1 Experimental Design

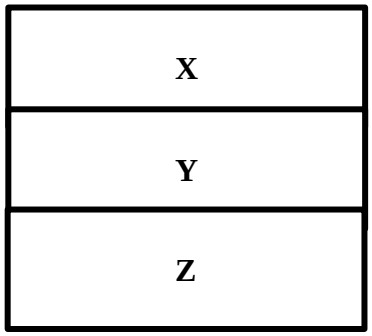
A randomized complete block design (RCBD) was employed, with three treatments replicated thirty times. The three treatments represent the different substrates: dried rice straw (Treatment X), dried banana leaves (Treatment Y), and dried cogon leaves (Treatment Z). The Randomized Complete Block Design (RCBD) is a statistical approach widely used in agricultural and biological research to control variability caused by external factors, such as environmental differences. By grouping similar experimental units into blocks and randomly assigning treatments within each block, RCBD minimizes within-block variability while isolating treatment effects (Plant Breeding & Genomics, 2019).

RCBD is effective for experiments where conditions vary significantly across blocks, such as field studies with spatial or soil differences. It is simple to implement and analyze using tools like ANOVA, ensuring robust comparison of treatment effects (Real Statistics Using Excel, 2024). However, it assumes no interaction between treatments and blocks. If this assumption is violated, alternative designs may be required. This design is particularly useful in plant breeding and agronomic trials. For example, it has been applied to evaluate crop yields under varying soil fertility levels or test the efficacy of fertilizers (Plant Breeding & Genomics, 2019).

2.2 Research Locale

This study was conducted in various locations within the third district of Negros Oriental, specifically in the municipalities of Siaton, Sta. Catalina, and Basay, and the City of Bayawan.

2.3 Experimental Plot Layout
The experimental plot layout is presented below, showing the legend and dimensions:



Legend:
X – Dried Rice Straw
Y – Dried Banana Leaves
Z – Dried Cogon Leaves

Dimensions:
Plot/Bed – 1 foot x 5 feet
Alley way – 2 feet

Figure 1. *Experimental Plot Layout*

2.4 Sampling
Thirty farmers were purposively selected to test the three substrates. This resulted in a total of 90 samples (3 treatments × 30 farmers). Each farmer provided the substrate materials, which were readily available locally. The number of plots was calculated as follows:

$$P_t = (F \times S \times T) = (10 \times 3 \times 3) = 90$$

Where:
Pt = total number of plots
F = number of farmer respondents per town or city (10)
S = number of substrates (3)
T = Town or City (3)

2.5 Materials and Procedures
Substrate Preparation
Clean, dried rice straw, banana leaves, and cogon leaves were collected two weeks before spawning. These substrates were air-dried for two weeks, soaked in water for 8 hours, and drained. The moist substrates were incubated in sealed plastic bags for 8 days to initiate the incubation process.

Substrate Disinfection/Sterilization
The substrates were disinfected by submerging them in a solution of hydrogen peroxide (20 ml hydrogen peroxide per 200 liters of chlorine-free water) for 8 hours. They were then drained until no water was dripping.

Spawn Beds/Block Preparation
Raised beds (1 foot x 5 feet) were prepared in shaded areas. Layers of disinfected substrate, 5 inches thick, were spread on the beds. The *Volvariella volvacea* spawn was evenly distributed between the layers. Each bed had 5 layers with a total of 100 grams of spawn per layer.

Care and Management
The beds were covered with plastic sheets, which were opened 4 days later to allow gas exchange during the primordial stage. Small holes were made to introduce oxygen. Four days after the primordial stage, pinheads appeared, and mushrooms were harvested from the fifth day onwards. Harvesting was performed daily before sunrise, and the plastic cover was replaced after each harvest.

2.6 Data Gathering and Analysis

Mushrooms were weighed immediately after each harvest. Data for each substrate were recorded in a matrix, and the total yield for each substrate was computed by summing the daily yields. The data were tabulated and analyzed using analysis of variance (ANOVA) and Duncan's multiple range test at the 5% and 1% significance levels.

2.7 Ethical Considerations

This research pass the ethical standards and was given by the research ethical standards committee. This research meets ethical standards and was approved by the research ethics committee.

3.0 Results and Discussion

3.1 Results from Bayawan City, Negros Oriental

The findings (Table 1) underscore the pivotal role of substrate choice in mushroom production. Dried rice straw emerges as the most productive substrate for *Volvariella volvacea* cultivation, yielding a mean of 1.204 kg. This is markedly higher than the yield from dried banana leaves (0.39 kg) and the absence of yield from dried cogon leaves. The latter suggests that this material may not offer the necessary nutrients or structural conditions for optimal mushroom growth. While dried banana leaves did yield mushrooms, it was at a significantly lower rate than rice straw. Villasol produced the highest yield (4.3 kg) among the different barangays, possibly due to favorable environmental conditions or better substrate management practices by local farmers. In contrast, Bugay recorded the lowest yield (0.4 kg), which could be attributed to less favorable growing conditions or variations in how the substrates were handled. These location-based differences highlight the importance of local environmental factors and the need for further research into how microclimates and farming practices affect mushroom production**.**

Table 1. *Summary of result collected from the selected ten barangays of Bayawan City*

Location	Treatment			Block	Grand	Grand
Bayawan City	X	Y	Z	Total	Total	Mean
Ali-is	1.35	0.00	0.00	1.35		
Banay-banay	0.59	0.15	0.00	0.74		
Banga	1.50	0.00	0.00	1.50		
Bugay	0.40	0.00	0.00	0.40		
Dawis	2.30	0.00	0.00	2.30		
Kalumboyan	1.10	0.70	0.00	1.80	15.9	1.59
Minaba	1.70	0.60	0.00	2.30		
Nangka	0.27	0.39	0.00	0.66		
Villareal	0.23	0.36	0.00	0.59		
Villasol	2.60	1.70	0.00	4.30		
Treatment Total	12.0	3.90	0.00			
Treatment Mean	1.20	0.39	0.00			

The Analysis of Variance (ANOVA) results (Table 2) further reinforce the importance of substrate type, with a highly significant treatment effect showing that the substrate substantially affects yield. Interestingly, the non-significant difference between blocks (locations) suggests that the geographic variation in the study sites within Bayawan City did not significantly impact mushroom production. This indicates that environmental factors such as microclimate, soil type, and farming practices across the different barangays were relatively uniform in their effects, allowing substrate type to emerge as the dominant variable influencing yield

Table 2. *Analysis of variance (ANOVA) of Bayawan City result*

SV	dF	SS	MS	obF	RF	
					0.05	0.01
Total	17	12.1				
Block	9	6.24	0.69	2.38	3.18	5.35
Treatment	1	3.32	3.32	11.4**	5.12	10.5
Error	9	2.59	0.29			

CV=33.87% **=highly significant

The results from Duncan's Multiple Range Test (Table 3) further validate dried rice straw as the most effective substrate, distinguishing it as significantly superior to banana and cogon leaves. This finding has important practical implications for local farmers and mushroom producers, as it provides evidence-based guidance for

improving production efficiency. Rice straw is readily available and cost-effective and offers a clear advantage in terms of yield potential, making it the best choice for *Volvariella volvacea* cultivation in Bayawan City and promising a bright future for the producers.

Table 3. *Duncan's multiple range test*

Treatment	Mean	Difference
X	1.2	X**
Y	0.39	0.81
Z		

3.2 Results from Sta. Catalina, Negros Oriental

As presented in Table 4, the results from Sta. Catalina once again confirm the superiority of dried rice straw (Treatment X) as the most effective substrate for *Volvariella volvacea* cultivation. With a mean yield of 2.24 kg, rice straw outperformed dried banana leaves (Treatment Y), which produced 1.33 kilograms. Importantly, dried cogon leaves (Treatment Z) yielded no mushrooms, consistently failing across multiple locations, which indicates its unsuitability as a substrate for mushroom production. This further underscores the undeniable superiority of rice straw as the preferred substrate for *Volvariella volvacea* cultivation. The findings in Sta. Catalina, echoing the earlier results from Bayawan City, confirm that rice straw is adaptable to various conditions, providing the ideal balance of nutrients, moisture retention, and aeration for optimal mushroom yield. This adaptability makes rice straw a confident choice for farmers in different regions, regardless of their specific environmental conditions. Among the barangays in Sta. Catalina and Amio recorded the highest yield (4.7 kg), likely due to favorable growing conditions or improved substrate management practices. On the other hand, Poblacion's lower yield (2.8 kg) may be attributed to less favorable conditions or less efficient handling of the substrate. However, rice straw was the most productive substrate even in Poblacion, further underscoring its reliability across diverse settings.

Table 4. *Summary of result collected from the selected ten barangays of the Municipality of Sta. Catalina*

Location	Treatment			Block	Grand	Grand
Sta. Catalina	X	Y	Z	Total	Total	Mean
Amio	2.50	2.20	0.00	4.70		
Caranoche	2.90	1.30	0.00	4.20		
Cawitan	3.30	1.20	0.00	4.50		
Fatima	1.80	1.10	0.00	2.90		
Kabulakan	2.10	1.00	0.00	3.10		
Manalongon	2.00	1.60	0.00	3.60	35.7	3.57
Nagbinlod	2.30	1.40	0.00	3.70		
Obat	2.00	1.30	0.00	3.30		
Poblacion	1.70	1.10	0.00	2.80		
San Francisco	1.80	1.10	0.00	2.90		
Treatment Total	22.4	13.3	0.00			
Treatment Mean	2.24	1.33	0.00			

The ANOVA results for Sta. Catalina, as shown in Table 5, aligns with those from Bayawan City, confirming that the choice of substrate significantly influences *Volvariella volvacea* yield. At the same time, the block (location) had no significant impact on production. This finding reinforces the conclusion that substrate selection is the most critical factor in mushroom cultivation, regardless of geographic variation. The consistency of this result across different locations highlights the universal effectiveness of dried rice straw as a substrate. The lack of significant variation due to location suggests that environmental factors such as temperature, humidity, and soil conditions in Sta. Catalina and Bayawan City are sufficiently uniform, or at least not influential enough, to affect mushroom yield. This implies that the performance of substrates, particularly dried rice straw, can be expected to hold across localities with similar climates. This consistency is an important consideration for farmers looking for reliable and replicable results, as it minimizes the need for location-specific adjustments and allows for broader application of the findings.

The significant effect of substrate choice, confirmed by the ANOVA and Duncan's Multiple Range Test, underscores the importance of using substrates that provide nutrients, moisture retention, and aeration. Dried rice straw has consistently met these requirements, making it the most effective substrate tested. The poor performance of cogon leaves, with no yield recorded in both locations, further emphasizes the need for careful substrate selection, as unsuitable materials can severely hinder production. While geographic location did not significantly

affect yield, slight variations in total production between barangays, such as Amio's higher yield and Poblacion's lower yield in Sta. Catalina suggests that localized farming practices or microenvironmental conditions could still play a role. However, the consistency of dried rice straw's performance across all test sites implies that its advantages outweigh any minor location-based differences. These findings offer valuable practical insights for mushroom producers. The consistent superiority of dried rice straw across different environments means that farmers can confidently adopt this substrate, knowing it will yield optimal results regardless of minor environmental or geographic differences. This eliminates much of the guesswork in substrate selection and allows for a more streamlined approach to mushroom cultivation.

Table 5. *Analysis of variance (ANOVA) of the Municipality of Sta. Catalina result*

SV	dF	SS	MS	obF	RF	
					0.05	0.01
Total	17	7.61				
Block	9	1.48	0.16	0.73	3.18	5.35
Treatment	1	4.15	4.15	18.8**	5.12	10.56
Error	9	1.98	0.22			

CV=13.14% **=highly significant

The results from Table 6 provide further confirmation that dried rice straw (Treatment X) is the most effective substrate for *Volvariella volvacea* cultivation, as validated by Duncan's Multiple Range Test. Rice straw's superior performance in both Sta. Catalina and Bayawan City make it the optimal choice for mushroom production across different locality, consistently yielding higher outputs than other substrates. These findings strongly support the recommendation of dried rice straw as the preferred substrate for mushroom farming, particularly in areas with similar environmental conditions to Sta. Catalina. The consistent results across multiple locations highlight that dried rice straw offers the ideal balance of physical structure, nutrient availability, and moisture retention for promoting mushroom growth. This consistency, confirmed by both ANOVA and Duncan's Multiple Range Test, makes rice straw a highly reliable substrate, eliminating much of the uncertainty accompanying mushroom cultivation. Unlike dried banana leaves (Treatment Y), which produced moderate yields, and dried cogon leaves (Treatment Z), which consistently failed to support mushroom growth, rice straw proved effective in maximizing yield across varied environments.

Table 6. *Duncan's multiple range test*

Treatment	Mean	Difference
X	2.24	X**
Y	1.33	0.91
Z		

3.3 Results from Basay, Negros Oriental

The results from Table 7 further reinforce the consistent superiority of dried rice straw (Treatment X) as the most effective substrate for *Volvariella volvacea* cultivation. In Basay, dried rice straw achieved a mean yield of 2.15 kg, outperforming dried banana leaves (Treatment Y), which produced a mean yield of 1.3 kg. Once again, dried cogon leaves (Treatment Z) yielded no mushrooms, underscoring its ineffectiveness as a substrate across multiple locations. The consistently strong performance of dried rice straw across different locations—whether in Bayawan City or Sta. Catalina, or Basay—validates its recommendation as the ideal substrate for mushroom cultivation. Its ability to provide the necessary nutrients, moisture retention, and structure needed for *Volvariella volvacea* growth is now well-established through both statistical analyses and practical results. The complete failure of cogon leaves to support mushroom yield in any location, as reiterated here, suggests that this substrate lacks the essential qualities required for fungal development, likely due to its poor nutrient content or inadequate water-holding capacity.

In Basay, the variation in yields between barangays—Cabalayungan producing the highest yield at 4.2 kg and Balos yielding the lowest at 2.5 kg—may indicate localized differences in microclimatic conditions or farming practices. This further reinforces the critical role of substrate selection, regardless of location. The practical implications of these findings for farmers in Basay are clear: using dried rice straw as the primary substrate for *Volvariella volvacea* cultivation offers the best opportunity for maximizing yields. The availability of rice straw as an agricultural byproduct makes it both affordable and sustainable, allowing farmers to enhance productivity without incurring significant additional costs. Moreover, the predictable performance of rice straw across different

locations and environmental conditions makes it a reliable choice for expanding mushroom farming in areas with similar climates.While banana leaves (Treatment Y) demonstrated some yield potential, their lower overall performance than rice straw suggests they may be best suited as a secondary or supplementary substrate rather than the primary option. The consistency of the results across multiple locations supports the broader recommendation for farmers to prioritize rice straw over banana leaves or other less effective substrates.

Table 7. *Summary of result collected from the selected ten barangays of the Municipality of Basay*

Location	Treatment			Block	Grand	Grand
Basay	X	Y	Z	Total	Total	Mean
Actin	1.90	1.40	0.00	3.30		
Bal-os	1.50	1.00	0.00	2.50		
Bongalonan	2.10	1.00	0.00	3.10		
Cabalayungan	2.40	1.80	0.00	4.20		
Cabatuanan	2.20	1.20	0.00	3.40		
Cabudlisan	1.70	1.30	0.00	3.00	34.5	3.45
Daro	2.20	1.20	0.00	3.40		
Maglinao	2.60	1.40	0.00	4.00		
Poblacion	2.60	1.40	0.00	4.00		
Yardahan	2.30	1.30	0.00	3.60		
Treatment Total	21.5	130	0.00			
Treatment Mean	2.15	1.30	0.00			

The ANOVA results for Basay, as shown in Table 8, further underscore the critical importance of substrate selection in *Volvariella volvacea* cultivation. With a highly significant Treatment F-value of 72.40, it is clear that the type of substrate had a profound effect on mushroom yield. At the same time, the Block F-value of 2.8—non-significant—indicates that the location or environmental variations across different barangays did not substantially influence production outcomes. This mirrors the findings from Bayawan City and Sta. Catalina reinforces substrate choice's central role in driving mushroom yield, irrespective of geographic location. The highly significant impact of substrate type, reflected in the ANOVA results, once again highlights dried rice straw (Treatment X) as the superior substrate for mushroom cultivation. This conclusion is supported by the consistently higher yields associated with rice straw across multiple locations, including Basay. The substrate's ability to provide an optimal environment for fungal growth—likely due to its superior nutrient availability, moisture retention, and structural properties—makes it the best option for maximizing yield.

In contrast, dried banana leaves (Treatment Y) produced lower yields, while dried cogon leaves (Treatment Z) showed no potential as a viable substrate. The non-significant Block F-value suggests that geographic variations in Basay, such as differences in microclimate or soil quality across barangays, had little to no effect on mushroom yield. This is a critical finding for farmers, as it confirms that focusing on substrate selection is far more critical than considering location-specific factors when improving mushroom production. The practical implication is that farmers across different barangays in Basay can confidently adopt dried rice straw as their primary substrate, knowing that it will yield consistent results regardless of their specific location. These results also reinforce the broader conclusions drawn from the previous analyses of Bayawan City and Sta. Catalina. The consistency of the findings across these diverse locations supports the recommendation that dried rice straw is the most effective substrate not only within Basay but also throughout Negros Oriental and similar agricultural areas. This reliability offers farmers a clear, evidence-based strategy for optimizing their mushroom cultivation efforts, reducing the uncertainty often associated with geographic or environmental differences.

Table 8. *Analysis of variance (ANOVA) of the Municipality of Basay result*

SV	dF	SS	MS	obF	RF	
					0.05	0.01
Total	17	5.28				
Block	9	1.23	0.14	2.80	3.18	5.35
Treatment	1	3.62	3.62	72.4**	5.12	10.5
Error	9	0.43	0.05			

CV=6 % **=highly significant

In conclusion, the ANOVA results for Basay confirm that substrate choice, specifically dried rice straw, is the primary determinant of mushroom yield in *Volvariella volvacea* cultivation. The non-significant effect of location demonstrates that substrate performance remains consistent across geographic variations, making dried rice straw

the most reliable and effective option for mushroom farmers in Basay. As the findings align with those from other locations, farmers are strongly encouraged to adopt this substrate to maximize production efficiency and yield, contributing to more sustainable and profitable mushroom farming practices

The results from Table 9, derived from Duncan's Multiple Range Test, provide definitive statistical confirmation of the superiority of dried rice straw (Treatment X) as the substrate of choice for *Volvariella volvacea* cultivation in Basay. Duncan's test, designed to compare multiple treatment means, clearly distinguishes dried rice straw as significantly more effective than dried banana leaves (Treatment Y) and dried cogon leaves (Treatment Z). This finding corroborates the results from the earlier ANOVA, further strengthening the conclusion that substrate choice, particularly the use of rice straw, plays a critical role in achieving optimal mushroom yields. The significant difference highlighted by Duncan's Multiple Range Test confirms the effectiveness of dried rice straw. It emphasizes the marked underperformance of alternative substrates, particularly dried cogon leaves, which failed to produce any yield.

This aligns with the results observed in Bayawan City and Sta. Catalina, where dried cogon leaves consistently proved ineffective. Dried banana leaves were significantly outperformed by dried rice straw while offering moderate yields, underscoring the latter's superior ability to support robust mushroom growth. The findings are particularly valuable for farmers in Basay, as they provide clear, data-driven guidance on maximizing mushroom production. The statistical rigor of Duncan's test eliminates any doubt about the reliability of these conclusions, reinforcing the practical recommendation that dried rice straw should be the primary substrate for *Volvariella volvacea* cultivation. The consistent success of rice straw across different barangays, regardless of environmental conditions, further solidifies its status as the most dependable option for mushroom farming. From a broader perspective, these results highlight the importance of selecting substrates that provide the necessary nutrients for fungal growth and maintain the right physical properties, such as moisture retention and structural integrity. Rice straw, an abundant agricultural byproduct, offers the ideal combination of these qualities, making it both an environmentally sustainable and economically viable choice for farmers.

In contrast, while somewhat effective, banana leaves may lack the nutrient profile or moisture retention capacity needed for optimal growth, and cogon leaves appear unsuitable for cultivation due to their failure to support any mushroom yield. Duncan's Multiple Range Test results also reinforce the notion that location-specific factors such as microclimate or soil conditions have little impact on the effectiveness of the substrate. The significant results for substrate type, combined with the non-significant block effects shown in the ANOVA, suggest that farmers in Basay—and indeed in similar regions—can confidently use dried rice straw without making adjustments based on geographic or environmental variables. This makes the cultivation process more predictable and easier to manage, especially for small-scale farmers who may lack the resources to adapt their practices to varying local conditions.

Table 9. *Duncan's multiple range test*

Treatment	Mean	Difference
X	12.1	X
Y	1.30	0.85
Z		

3.4 Consolidated Results from Bayawan City, Sta. Catalina, and Basay

Table 10 consolidates the yield data across Bayawan City, Sta. Catalina and Basay provided a comprehensive comparison of the effectiveness of the three substrates tested—dried rice straw (Treatment X), dried banana leaves (Treatment Y), and dried cogon leaves (Treatment Z). The results reveal that Treatment X consistently outperformed the other substrates, with an overall mean yield of 1.86 kg, followed by Treatment Y at 1.01 kg. Treatment Z produced no yield, reaffirming its ineffectiveness as a substrate for *Volvariella volvacea* cultivation. The superior performance of dried rice straw across all locations highlights its ability to provide the necessary environment for optimal mushroom growth. Its high nutrient availability, water retention capacity, and suitable texture make it the most efficient substrate, supporting robust fungal growth. In contrast, while yielding some mushrooms, dried banana leaves consistently lagged, suggesting that although it may be a viable secondary option, it lacks the critical properties required for maximizing yield. On the other hand, dried cogon leaves failed

to produce any mushrooms, which may be attributed to poor nutrient content or inadequate moisture retention, rendering them unsuitable for mushroom farming.

Among the three locations, Sta. Catalina produced the highest total yield at 3.57 kg, emphasizing the overall effectiveness of dried rice straw, particularly in environments with favorable microclimatic conditions. Despite these conditions, the dominance of dried rice straw as the leading substrate remains consistent, with the results indicating that factors such as microclimate or slight environmental variations had minimal impact on overall yield. The lowest total yield was recorded in Bayawan City (1.59 kg), suggesting that factors like farm management, preparation techniques, or environmental stressors could have affected the performance. However, the yield from dried rice straw remained relatively stable. The data underscore the importance of substrate selection as a critical driver of *Volvariella volvacea* yield. The non-performance of cogon leaves across all locations confirms its inadequacy for mushroom cultivation, eliminating it as a viable option. Meanwhile, the moderate performance of banana leaves suggests that although they are better than cogon, they remain suboptimal compared to rice straw. Farmers seeking to maximize their production would benefit significantly from prioritizing dried rice straw, given its consistent ability to deliver the highest yields across multiple environments.

Table 10. *Summary of result collected from the Municipalities of Sta. Catalina and Basay and the City of Bayawan*

Location	Treatment Mean			Block Total	Grand Total	Grand Mean
	x	y	z			
Bayawan City	1.20	0.39	0.00	1.59		
Sta. Catalina	2.24	1.33	0.00	3.57		
Basay	2.15	1.30	0.00	3.45	8.61	2.87
Treatment Total	5.59	3.02	0.00			
Treatment Mean	1.86	1.01	0.00			

The overall ANOVA results in Table 11 provide valuable insights into the factors influencing mushroom yield across the three study locations. With a highly significant Treatment F-value of 68.75, the analysis confirms that substrate type is a major determinant of *Volvariella volvacea* yield. This result aligns with the earlier location-specific findings, emphasizing that dried rice straw (Treatment X) consistently outperformed the other substrates. The significant effect of substrate choice reiterates its critical role in mushroom cultivation, with rice straw offering the optimal environment for growth due to its superior moisture retention, nutrient content, and structural properties. In contrast, banana leaves (Treatment Y), while moderately effective, and cogon leaves (Treatment Z), which produced no yield, failed to match rice straw's performance, reaffirming their limited utility for large-scale mushroom farming.

However, what stands out in Table 11 is the highly significant Block F-value of 76.25, indicating that the location (block) also had a substantial impact on mushroom yield when data from all locations were aggregated. This result contrasts with the earlier non-significant block effects observed within individual locations, suggesting that microclimatic or geographic differences might not drastically affect yield within a specific site. However, they become more pronounced when examining the results across multiple locations. This finding underscores the importance of considering regional environmental factors such as microclimate, soil composition, humidity levels, and local farming practices, all of which may contribute to yield variability. The significant impact of location may also reflect differences in farm management techniques, such as how substrates are prepared, maintained, or harvested. Variations in moisture control, substrate depth, or harvest timing could contribute to the higher yields observed in certain barangays, such as Sta. Catalina had the highest overall yields.

These location-specific factors introduce an additional layer of complexity to mushroom cultivation, suggesting that while dried rice straw is the most effective substrate across all environments, farmers may still need to tailor their practices to suit the specific conditions of their local environment to achieve maximum yield potential. The fact that substrate type and location significantly influenced yield has important practical implications. For farmers, it means that while choosing the suitable substrate—dried rice straw—is critical, they must also be mindful of local environmental conditions that could impact production. This reinforces the need for adaptive farming practices considering local variations in climate, soil, and resource availability. Farmers in areas with more challenging environmental conditions may need to implement additional strategies, such as optimizing water retention or enhancing substrate nutrition, to compensate for these regional differences.

Table 11. *Analysis of variance (ANOVA) of the overall result*

SV	dF	SS	MS	obF	RF	
					0.05	0.01
Total	8	2.35				
Block	2	1.22	0.61	76.2**	3.18	5.35
Treatment	2	1.10	0.55	68.7**	5.12	10.5
Error	4	0.03	0.00			

CV=3 % **=highly significant

The results summarized in Table 12 provide compelling evidence that dried rice straw (Treatment X) is the most effective substrate for Volvariella volvacea cultivation across all study locations. Duncan's Multiple Range Test confirms this superiority by demonstrating significant differences in yield between rice straw and the other substrates, specifically dried banana leaves (Treatment Y) and dried cogon leaves (Treatment Z). This outcome underscores the importance of substrate selection in maximizing mushroom production. The consistent performance of dried rice straw highlights its intrinsic properties that favor mycelial growth and fruiting body development. Its high moisture retention, rich nutrient content, and optimal structure create an ideal microenvironment for Volvariella volvacea, facilitating higher yields.

In contrast, while dried banana leaves yielded some mushrooms, their overall performance was significantly lower than rice straws, indicating that they may need to provide a different level of support for successful cultivation. The total absence of yield from cogon leaves across all locations reinforces its inadequacy as a viable substrate for mushroom farming, suggesting that factors such as poor nutrient content or inappropriate moisture retention may have severely limited fungal growth. These findings have substantial implications for local farmers and the agricultural community. By identifying dried rice straw as the superior substrate, growers can make informed decisions that optimize their production practices. This focus on an effective substrate enhances yield potential and promotes economic viability, as increased mushroom production can lead to higher incomes for farmers.

Furthermore, Duncan's test affirms rice straw's effectiveness and highlights the significance of utilizing agricultural byproducts in sustainable farming practices. The integration of rice straw into mushroom cultivation provides a secondary income stream for farmers and contributes to waste reduction and improved environmental stewardship. As rice straw is readily available in rice-producing regions, its utilization aligns with sustainability principles, turning agricultural waste into a resource that fosters food security and economic resilience. Additionally, the confirmation of rice straw's efficacy across diverse locations suggests that it is adaptable to various microclimatic conditions, making it a reliable substrate for mushroom cultivation in different environments. This adaptability encourages its adoption among farmers in different barangays, promoting a more extensive and successful mushroom production network.

Table 12. *Duncan's multiple range test*

Treatment	Mean	Difference
X	1.86	X
Y	1.01	0.85
Z		

The results of this study reveal a highly significant difference in mushroom yield based on the substrate utilized, with dried rice straw consistently outperforming other substrates across all locations. This underscores the critical role that substrate selection plays in the successful cultivation of *Volvariella volvacea*. The superior performance of dried rice straw can be attributed to its rapid decomposition rate, which effectively releases essential nutrients into the growing environment. Its physical structure and nutrient profile facilitate this rapid breakdown, creating a conducive microenvironment that supports vigorous mycelial colonization and subsequently leads to higher fruiting body yields. In comparison, while providing some nutritional benefits, dried banana leaves demonstrated lower effectiveness as a substrate for mushroom production. The slower decomposition rate of banana leaves limits the immediate availability of nutrients necessary for optimal growth, hindering mycelial development and fruiting. This highlights the importance of not only nutrient content but also the decomposition dynamics of the substrate in determining the success of mushroom cultivation.

The results concerning dried cogon leaves are particularly revealing. The lack of mushroom production from cogon leaves emphasizes their unsuitability as a substrate for *Volvariella volvacea* cultivation. This ineffectiveness can be attributed mainly to their high lignin content and overall low nutrient availability, which impede microbial activity necessary for decomposition. The inability of cogon leaves to break down adequately during the study precluded mushroom growth and suggests that they may hinder overall soil health and biodiversity if used in agricultural practices. These findings provide critical insights for mushroom farmers, indicating that selecting an appropriate substrate is vital for optimizing yield potential. Dried rice straw emerges as the clear choice for those aiming to enhance their mushroom production, owing to its rapid decomposition and rich nutrient release. Additionally, this study underscores the importance of integrating agricultural byproducts, such as rice straw, into sustainable farming practices. By utilizing readily available materials, farmers can increase their mushroom yields and contribute to waste reduction and environmental sustainability.

Furthermore, the significant differences in yields observed across different substrates highlight the need for ongoing research into substrate management strategies. Future studies could explore combining substrates or adding nutritional amendments to enhance yields further and address potential limitations of other materials. Understanding how different substrates interact within various environmental conditions could lead to optimized practices that maximize mushroom production. In conclusion, the significant variation in mushroom yields based on substrate choice elucidates the importance of effective substrate management in cultivating *Volvariella volvacea*. The study's findings advocate using dried rice straw as the optimal substrate, providing a robust foundation for enhancing agricultural productivity while supporting sustainable practices. Farmers can improve their mushroom production outcomes by prioritizing suitable substrates and contributing to local food security initiatives.

The findings of this study align with recent literature highlighting the critical role of substrate selection in mushroom cultivation. For instance, Iqbal et al. (2019) emphasized the superior performance of rice straw due to its rapid decomposition and nutrient release, consistent with this study's results. Similarly, Mushungwa et al. (2020) reported that banana leaves, while nutritionally beneficial, decompose more slowly, limiting their effectiveness as a substrate. Singh et al. (2021) further corroborated that high lignin content in materials like cogon leaves inhibits decomposition, rendering them unsuitable for mushroom cultivation. Furthermore, studies such as those by Royse et al. (2021) emphasize the potential of combining substrates or adding nutritional supplements to enhance yields, supporting the study's recommendations for future research. These findings reinforce the importance of substrate selection and innovation in optimizing mushroom yields and promoting sustainable agricultural practices.

4.0 Conclusions

This study conclusively demonstrates that substrate choice is critical in successfully cultivating *Volvariella volvacea*, with dried rice straw emerging as the most effective substrate across multiple locations. The significant differences in mushroom yield based on substrate type underscore the importance of utilizing materials that decompose rapidly and provide adequate nutrients. Dried rice straw supports vigorous mycelial growth and enhances overall yield potential, making it the recommended substrate for farmers aiming to optimize their mushroom production. The findings further emphasize the feasibility of cultivating *Volvariella volvacea* in backyard settings, utilizing locally available materials. This accessibility empowers individuals and communities to engage in sustainable agricultural practices, promoting self-sufficiency. Importantly, the cultivation process is simple and straightforward, allowing even those with minimal gardening experience to participate, contributing to increased food production and security.

Additionally, this research highlights the economic viability of mushroom production, which requires minimal space, attention, and financial investment. By leveraging agricultural byproducts and employing efficient cultivation methods, farmers can generate additional income while supporting sustainable practices. Cultivating *Volvariella volvacea* offers a valuable solution to food security, particularly during crises such as the COVID-19 pandemic. Growing nutrient-rich mushrooms with limited resources can help mitigate food shortages and enhance community dietary diversity. As global challenges persist, your role in fostering local production systems will be essential for building resilience and ensuring stable food supplies. In conclusion, successfully cultivating *Volvariella volvacea* using dried rice straw optimizes yield and aligns with broader goals of sustainability, economic stability, and food security. Future research should further explore innovative cultivation techniques and substrate

combinations to enhance productivity and resilience in mushroom farming. Investing in these practices can support local communities and contribute to a more sustainable food system.

5.0 Contribution of Author

This research is conducted by a sole researcher.

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7.0 Conflict of Interest

The author declares no conflict of interest about the publication of this paper.

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9.0 References

Belewu, M.A., & Belewu, K.Y. (2019). Cultivation of mushroom (Volvariella volvacea) on banana leaves. African Journal of Biotechnology, 4(12), 1401-1403. https://tinyurl.com/ym87nrum

Hao, H., Yue, Y., Wang, Q., Xiao, T., Zhao, Z., Zhang, J., & Chen, H. (2024). Effects of the rice-mushroom rotation pattern on soil properties and microbial community succession in paddy fields. Frontiers in Microbiology, 15. https://doi.org/10.3389/fmicb.2024.1449922

Iqbal, S. M., Rauf, S., & Khalid, A. (2019). Optimizing yield through substrate supplementation in mushroom production. Journal of Environmental Science and Management, 22(1), 102–112.

Javad, A., Ali, A., & Ali, S. (2020). Edible mushrooms as a nutraceutical resource: A review. Current Nutrition Reports, 9(2), 30–40. https://doi.org/10.1007/s13668-020-00309-7

Kumla, J., Zhao, Y., & Kakumyan, P. (2022). Lignocellulosic substrates in mushroom production: Effects of microbial communities. Biology, 11(4), 569. https://doi.org/10.3390/biology11040569

Mushungwa, S., Marfo, J., & Agyei, O. (2020). The role of decomposition rate in mushroom cultivation using banana leaves as substrate. International Journal of Agriculture and Biology, 23(5), 743–749.

Niazi, S., & Ghafoor, A. (2021). Nutritional and health benefits of mushrooms: A review. Food Reviews International, 37(2), 140–158. https://doi.org/10.1080/87559129.2020.1831791

Royse, D. J., Baars, J., & Tan, Q. (2021). Advances in substrate innovation for mushroom production. Edible Fungi Research Journal, 18(3), 205–214.

Singh, R., Devi, U., & Sharma, S. (2021). Lignin-rich substrates and their effects on mushroom cultivation. Biotechnology Reports, 30, e00602.