



# EFFECTS OF DIFFERENT SAWDUST, CORN COB, AND RICE HUSK SUBSTRATE COMPOSITIONS ON THE GROWTH AND YIELD OF WHITE OYSTER MUSHROOM (*Pleurotus ostreatus*)

## PENGARUH BERBAGAI KOMPOSISI SERBUK KAYU, TONGKOL JAGUNG, DAN KULIT BERAS TERHADAP PERTUMBUHAN DAN HASIL JAMUR TIRAM PUTIH (*Pleurotus ostreatus*)

Asep Ginanjar Arip<sup>1,2\*</sup>, Anna Fitri Hindriana<sup>2</sup>, Zaenal Abidin<sup>2</sup>

<sup>1</sup>Universitas Siliwangi, Siliwangi St No 24, 46115, Tasikmalaya

<sup>2</sup>Universitas Kuningan, Cut Nyak Dhien St No. 35A, 45513, Kuningan

\*Corresponding author: asepginajararip@unsil.ac.id

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### Abstract

White oyster mushroom (*Pleurotus ostreatus*) is an edible mushroom widely cultivated due to its nutritional and economic value. This study aimed to evaluate the effect of different substrate compositions of sawdust, corn cobs, and rice husks on the growth and yield of white oyster mushrooms. The experiment was conducted using a Completely Randomized Design (CRD) with four treatments and five replications, resulting in 20 experimental units. Growth parameters observed included stipe length, pileus diameter, fruiting body mass, and the number of fruiting bodies. The results showed that substrate composition significantly affected mushroom growth and productivity. The K2 treatment, consisting of 30% sawdust, 40% corn cobs, and 30% rice husks, produced the best performance in all observed parameters. The higher proportion of corn cobs in the substrate likely provided favorable conditions for mushroom development and yield. In conclusion, a substrate composed of 30% sawdust, 40% corn cobs, and 30% rice husks is recommended for the cultivation of white oyster mushrooms because it promotes optimal growth and productivity.

**Keywords:** Corn cobs; *Pleurotus ostreatus*; Rice husks; Sawdust

### Abstrak

Jamur tiram putih (*Pleurotus ostreatus*) merupakan jamur pangan yang banyak dibudidayakan karena memiliki nilai gizi dan ekonomi yang tinggi. Penelitian ini bertujuan untuk mengevaluasi pengaruh berbagai komposisi substrat serbuk gergaji, tongkol jagung, dan sekam padi terhadap pertumbuhan dan hasil jamur tiram putih. Percobaan dilakukan menggunakan Rancangan Acak Lengkap (RAL) yang terdiri atas empat perlakuan dan lima ulangan, sehingga terdapat 20 satuan percobaan. Parameter yang diamati meliputi panjang tangkai buah (stipe), diameter tudung (pileus), bobot tubuh buah, dan jumlah tubuh buah. Hasil penelitian menunjukkan bahwa komposisi substrat berpengaruh nyata terhadap pertumbuhan dan produktivitas jamur tiram putih. Perlakuan K2 yang terdiri atas 30% serbuk gergaji, 40% tongkol jagung, dan 30% sekam padi memberikan hasil terbaik pada seluruh parameter yang diamati. Proporsi tongkol jagung yang lebih tinggi dalam substrat diduga mampu menyediakan kondisi yang lebih baik bagi pertumbuhan dan hasil jamur. Dengan demikian, komposisi substrat yang terdiri atas 30% serbuk gergaji, 40% tongkol jagung, dan 30% sekam padi direkomendasikan untuk budi daya jamur tiram putih karena mampu mendukung pertumbuhan dan produktivitas secara optimal.

**Kata Kunci:** *Pleurotus ostreatus*; Sekam padi; Serbuk gergaji; Tongkol jagung

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## INTRODUCTION

Among edible mushroom species, *P. ostreatus* is one of the most extensively cultivated and utilized worldwide, owing to its nutritional benefits, rapid development, and adaptability to various growing substrates and conditions. They are named for their characteristic oyster-like shape and are prized not only for their culinary appeal but also for their medicinal and environmental benefits. Rich in essential nutrients such as proteins, vitamins, minerals, and bioactive compounds, oyster mushrooms have garnered attention as a functional food with potential health-promoting properties (Lesa et al., 2022; Irfan et al., 2022).

The production of oyster mushrooms offers a practical and eco-friendly strategy for converting agricultural waste into valuable biomass. They can grow on a wide range of lignocellulosic substrates, such as straw, sawdust, and corn cobs, which makes them an excellent tool for bioconversion and waste management (Jimenez et al., 2025). In addition to their role in food production, oyster mushrooms are known for their potential applications in bioremediation, as they can degrade pollutants and heavy metals in contaminated environments (Moses, 2024).

The successful cultivation of oyster mushrooms depends on multiple factors, such as temperature, relative humidity, substrate characteristics, and the genetic strain used, despite their adaptability and numerous benefits. Understanding the biological, physiological, and ecological aspects of *Pleurotus* spp. is essential to optimize production and maximize yield (Aditya et al., 2024). Another factor is that the composition of cultivation substrates plays an important role in determining the biological properties of the substrate, such as microbial community dynamics and activity, which in turn can affect the biological efficiency of mushrooms (Kumla et al., 2020; Suwannarach et al., 2022).

Sawdust is a byproduct of the timber industry and is commonly used as a substrate for oyster mushroom cultivation due to its high lignin and cellulose content. These components are essential for the growth of *P. ostreatus*, which secretes enzymes to break down complex polymers into simpler compounds that can be absorbed as nutrients. Sawdust is widely available, cost-effective, and provides a suitable texture and structure for mycelial colonization. However, the nutrient content of sawdust may vary depending on the type of wood, necessitating supplementation with nitrogen sources such as bran or urea for optimal growth (Kumla et al., 2020).

As a major by-product of rice cultivation and processing, rice husks are abundantly produced in regions where rice is extensively cultivated. They contain cellulose, hemicellulose, and silica, which make them a potential substrate for mushroom cultivation (Zárate-Salazar et al., 2020; Akcay et al., 2023; Costa et al., 2023; Miśkiewicz et al., 2025). Rice husks are an abundant agricultural by-product that can be utilized as a substrate component for *P. ostreatus* cultivation. However, their direct use is often limited by low nutritional quality and high silica content, which may reduce substrate utilization efficiency and mushroom yield. Therefore, rice husks are commonly combined with other lignocellulosic materials, such as sawdust, to improve substrate suitability and productivity. Nevertheless, rice husks remain an inexpensive, widely available, and environmentally sustainable substrate material (Costa et al., 2023).

As an agricultural residue generated from corn production, corn cobs serve as an alternative lignocellulosic substrate for cultivating mushrooms. Corn cobs are rich in hemicellulose and cellulose, providing an alternative to traditional substrates like sawdust. They are lightweight, porous, and capable of retaining moisture, which supports the growth of *P. ostreatus*. A recent study on corncob-based substrates compared 100% sawdust with mixtures containing corncob and found that oyster mushrooms grew and yielded successfully on corncob substrates, further supporting the feasibility of replacing sawdust where it is limited (Mangilog et al., 2024).

Sawdust serves as a widely used cultivation substrate for the growth of white oyster mushrooms (*P. ostreatus*). However, in addition to sawdust, oyster mushrooms are also capable of growing on other media, such as corn cobs and rice husks. The growth of oyster mushrooms on these alternative media depends on their nutrient content (Maheswari et al., 2020; Paudel & Dhakal, 2020).

Differences exist in the nutritional profiles of sawdust, corn cobs, and rice husks, reflecting their distinct chemical compositions. Therefore, the present study was undertaken to determine the

influence of various substrate compositions on mushroom growth and to identify the most effective substrate formulation for cultivating white oyster mushrooms.

## **MATERIALS AND METHODS**

The experiment was implemented through a series of carefully controlled procedures to ensure consistency and reliability of the results. The stages of the research are described as follows:

### **Preparation of Cultivation Substrates**

The substrate preparation process involved the selection of suitable substrate materials and their subsequent formulation. Proper selection of substrate components is essential, as it greatly influences the growth performance and productivity of oyster mushrooms.

### **Sieving**

The sawdust was sieved to obtain a uniform particle size and to determine the maximum particle size used in the substrate formulation. This process ensured homogeneous mixing of sawdust with the other substrate components.

### **Mixing**

A total of 6,666.5 g of sieved sawdust was mixed with lime and other substrate materials according to the treatment compositions. Each kilogram of substrate was formulated using different proportions of sawdust, corn cobs, and rice husks as follows, K0= 33.33% sawdust + 33.33% corn cobs + 33.33% rice husks; K1= 40% sawdust + 30% corn cobs + 30% rice husks; K2: 30% sawdust + 40% corn cobs + 30% rice husks; and K3: 30% sawdust + 30% corn cobs + 40% rice husks. All materials were thoroughly mixed to ensure a uniform distribution of nutrients throughout the substrate.

### **Bagging**

The substrate mixtures consisting of sawdust, corn cobs, and rice husks were packed into polypropylene bags measuring 25 cm × 35 cm × 0.3 mm. The substrate was then compressed using a pressing device to obtain a compact mushroom cultivation bag. After compaction, the plastic bags were neatly folded and securely tied with string.

### **Sterilization**

The packed substrate bags were sterilized at a temperature of 80–90 °C for 6–8 h using steam heat. Sterilization was performed in a simple steaming apparatus constructed from a used oil drum equipped with a wire mesh separator that separated the water reservoir at the bottom from the substrate bags positioned above it. After sterilization, the steamer was opened, and the baglogs were left undisturbed for approximately 5 h to allow the substrate temperature to return to ambient conditions.

### **Cooling**

Following sterilization, the Mushroom cultivation bags were arranged vertically and cooled for 12 h using forced-air ventilation provided by an electric fan. This cooling period ensured that the substrate temperature was suitable for subsequent inoculation with mushroom spawn.

### **The Inoculation**

The inoculation stage involved introducing half a bottle of F2 oyster mushroom spawn into the cultivation substrate that had previously been heat-treated. The inoculation process was conducted under aseptic conditions to prevent contamination by undesirable microorganisms that could interfere with mushroom growth. For inoculation, a spatula stirring rod was prepared and sterilized by spraying it with 70% alcohol, followed by flaming with a spirit lamp. The spawn was inoculated using the surface-spreading method, in which the mushroom spawn was evenly distributed over the surface of the cultivation substrate. Before application, the spawn was gently mixed using a sterilized spatula to

facilitate pouring and distribution. The plastic bag containing the substrate was opened, and white oyster mushroom (*P. ostreatus*) spawn was applied at a rate of five spatula scoops per kilogram of substrate and spread evenly across the substrate surface. After inoculation, a PVC ring was attached to the neck of the plastic bag, which was then covered with newspaper and secured with a rubber band. The inoculated cultivation media were transferred to a designated incubation room for mycelial development. The incubation process was conducted in a closed, relatively dark, and warm environment to facilitate optimal fungal growth. Environmental conditions within the incubation room were maintained at a temperature range of 22–28 °C and a relative humidity of 60–70%, providing suitable conditions for mycelial colonization of the substrate.

The experiment included one control and three treatment groups, each characterized by different compositions of sawdust, corn cobs, and rice husks, as detailed in Table 1. The design of the research used was a Completely Randomized Design (CRD) consisting of 4 treatments with different compositions of sawdust, corn cobs, and rice husks.

**Table 1.** Percentage composition of sawdust, corn cobs, and rice husks in each treatment

Treatment	Media composition		
	Sawdust (%)	Corn cobs (%)	Rice husks (%)
K <sub>0</sub>	33.33	33.33	33.33
K <sub>1</sub>	40	30	30
K <sub>2</sub>	30	40	30
K <sub>3</sub>	30	30	40

Note: The percentage (%) of the growing media composition is based on the weight of the media

A minimum of five replications was assigned to each treatment, resulting in a total of 20 experimental units (treatments × replications). The experiment employed a Completely Randomized Design (CRD), with the treatment arrangement shown in Table 2.

**Table 2.** Experimental design layout

1	2	3	4
K1 <sub>1</sub>	K0 <sub>2</sub>	K3 <sub>3</sub>	K1 <sub>4</sub>
5	6	7	8
K3 <sub>5</sub>	K2 <sub>6</sub>	K0 <sub>7</sub>	K1 <sub>8</sub>
9	10	11	12
K2 <sub>9</sub>	K3 <sub>10</sub>	K3 <sub>11</sub>	K2 <sub>12</sub>
13	14	15	16
K1 <sub>13</sub>	K2 <sub>14</sub>	K0 <sub>15</sub>	K2 <sub>16</sub>
17	18	19	20
K0 <sub>17</sub>	K1 <sub>18</sub>	K0 <sub>19</sub>	K3 <sub>20</sub>

Note: 1= indicates the sequential number of the experimental plots; K0= indicates the treatment; K01= indicates the treatment in the first replication

The research parameters measured are the number of fruiting bodies in a cluster, mushroom mass, and pileus diameter. Here are the definitions of those parameters:

### Number of Fruiting Bodies in a Cluster

The total number of fruiting bodies is observed and recorded, including large, medium, and small mushrooms. The results are then averaged for each replication.

### Mushroom Mass

The total mass of white oyster mushrooms in each cluster from the first harvest is immediately weighed using a bench scale in grams to determine the average mushroom mass per replication.

### Pileus Diameter

The diameter of the mushroom pileus is measured using a ruler in centimeters, horizontally across the width of the pileus. Measurements are taken individually for each fruiting body in the

cluster and then averaged for each replication. Observations of pileus diameter are conducted 3 days after the appearance of the fruiting body primordia (pinhead) during the first harvest.

### Data Analysis

A Completely Randomized Design (CRD) with four treatments was employed in this study. The observational data were analyzed using analysis of variance (ANOVA). If there are differences or significant results, further testing is conducted using the multiple range test (Duncan's test).

## RESULTS

Here will be explained, the results and discussion of the research conducted on the effect of different compositions of sawdust, corn cobs, and rice husks on the growth of white oyster mushrooms (*P. ostreatus*), focusing on the parameters of the number of fruiting bodies in a cluster, mushroom mass, pileus diameter, and stipe length.

### The Number of Fruiting Bodies in a Cluster of White Oyster Mushrooms (*Pleurotus ostreatus*)

The results of the analysis of the number of fruiting bodies per cluster of white oyster mushrooms (*P. ostreatus*) under different treatment compositions are presented in Table 3. The results presented in Table 3 indicate that different substrate compositions significantly affected the number of fruiting bodies produced by *P. ostreatus*. The highest average number of fruiting bodies was recorded in treatment K2 (30% sawdust, 40% corn cobs, and 30% rice husks), with an average of 20.0 fruiting bodies per mushroom cultivation bag. This value was significantly higher than those observed in the other treatments. Treatment K3 (30% sawdust, 30% corn cobs, and 40% rice husks) produced an average of 16.6 fruiting bodies, while treatment K1 (40% sawdust, 30% corn cobs, and 30% rice husks) yielded 15.6 fruiting bodies. The lowest average number of fruiting bodies was obtained in treatment K0, which consisted of equal proportions of sawdust, corn cobs, and rice husks (33.33% each), producing 13.8 fruiting bodies. The statistical grouping indicated by different letters shows that K2 differed significantly from K0, K1, and K3, suggesting that increasing the proportion of corn cobs in the substrate enhanced fruiting body formation.

**Table 3.** Average data of the number of fruiting bodies of white oyster mushrooms (*Pleurotus ostreatus*) (in units of fruit)

Treatment	Average number of fruiting bodies (fruit units)
K <sub>0</sub> = 33.33% + 33.33% + 33.33%	13.8 <sup>a</sup>
K <sub>1</sub> = 40% + 30% + 30%	15.6 <sup>ab</sup>
K <sub>2</sub> = 30% + 40% + 30%	20.0 <sup>c</sup>
K <sub>3</sub> = 30% + 30% + 40%	16.6 <sup>b</sup>

Note: Numbers in the same column followed by the same letter indicate no significant difference based on Duncan's test at a 5% significance level

### The Biomass of Oyster Mushrooms (*Pleurotus ostreatus*)

The results of the biomass analysis of oyster mushrooms (*P. ostreatus*) under various treatments with different compositions can be seen in Table 4. The results presented in Table 4 indicate that substrate composition had a significant effect on the biomass production of *P. ostreatus*. The highest average biomass was obtained in treatment K2, consisting of 30% sawdust, 40% corn cobs, and 30% rice husks, with a mean biomass of 137.0 g. According to the statistical grouping, K2 was significantly different from all other treatments, as indicated by the distinct letter "c".

**Table 4.** Average biomass data of oyster mushrooms (*Pleurotus ostreatus*)

Treatment	Average biomass (g)
K <sub>0</sub> = 33.33% + 33.33% + 33.33%	103.2 <sup>a</sup>
K <sub>1</sub> = 40% + 30% + 30%	125.4 <sup>b</sup>
K <sub>2</sub> = 30% + 40% + 30%	137.0 <sup>c</sup>
K <sub>3</sub> = 30% + 30% + 40%	120.0 <sup>b</sup>

Note: Numbers in the same column followed by the same letter indicate no significant difference based on Duncan's test at a 5% significance level

Treatment K1 (40% sawdust, 30% corn cobs, and 30% rice husks) produced an average biomass of 125.4 g, while treatment K3 (30% sawdust, 30% corn cobs, and 40% rice husks) yielded 120.0 g. Both treatments were assigned the same statistical grouping ("b"), indicating that there was no significant difference in biomass production between K1 and K3. However, both treatments produced significantly greater biomass than K0.

The lowest average biomass was observed in treatment K0, which contained equal proportions of sawdust, corn cobs, and rice husks (33.33% each), with a mean biomass of 103.2 g. This treatment was significantly different from the other treatments, as indicated by the letter "a". Overall, the results demonstrate that increasing the proportion of corn cobs in the substrate mixture to 40% (K2) significantly enhanced oyster mushroom biomass production. This finding suggests that corn cobs may provide a more favorable nutritional composition and lignocellulosic structure for mycelial growth and fruiting body development compared with the other substrate formulations.

### The Pileus Diameter of White Oyster Mushrooms (*Pleurotus ostreatus*)

The analysis results of the pileus diameter of white oyster mushrooms (*P. ostreatus*) under various treatments with different compositions can be seen in Table 5. Table 5 shows that different substrate compositions significantly affected the average cap diameter of white oyster mushrooms (*P. ostreatus*). Based on the mean separation test, treatments were grouped using different letter notations, indicating significant differences among treatments at the selected significance level. The largest average cap diameter was recorded in treatment K2 (30% sawdust + 40% corn cobs + 30% rice husks), with a mean value of 12.47 cm and the notation "d". This result was significantly higher than those obtained in K0 (7.86 cm; notation "a") and K1 (8.39 cm; notation "ac"). Treatment K3 (30% sawdust + 30% rice husks + 40% corn cobs) produced an intermediate cap diameter of 10.30 cm and was assigned the notation "bcd", indicating that it was not significantly different from K2 but tended to produce larger caps than K0 and K1. The lowest cap diameter was observed in K0, which consisted of equal proportions of sawdust, corn cobs, and rice husks (33.33% each), yielding an average diameter of 7.86 cm. Treatment K1, containing a higher proportion of sawdust (40%), resulted in a slightly larger cap diameter (8.39 cm), although it remained statistically comparable to K0 due to the shared letter notation. The superior performance of K2 suggests that increasing the proportion of corn cobs to 40% provided a more favorable substrate composition for cap development. Corn cobs are known to contain cellulose, hemicellulose, and other lignocellulosic compounds that can serve as important carbon sources for fungal growth and fruiting body formation.

**Table 5.** Data on average cap diameter of white oyster mushrooms (*Pleurotus ostreatus*)

Treatment	Average cap diameter (cm)
K <sub>0</sub> = 33.33% + 33.33% + 33.33%	7.86 <sup>a</sup>
K <sub>1</sub> = 40% + 30% + 30%	8.39 <sup>ac</sup>
K <sub>2</sub> = 30% + 40% + 30%	12.47 <sup>d</sup>
K <sub>3</sub> = 30% + 30% + 40%	10.30 <sup>bcd</sup>

Note: Numbers in the same column followed by the same letter indicate no significant difference based on Duncan's test at a 5% significance level

Overall, the results indicate that the substrate composition significantly influenced cap diameter, with the highest value obtained from K2. This finding suggests that the incorporation of 40% corn cobs into the growing medium can enhance the morphological development of oyster mushroom fruiting bodies, particularly cap expansion, thereby potentially improving marketable yield and quality.

### Stipe Length in White Oyster Mushrooms (*Pleurotus ostreatus*)

The results of the analysis of the pileus length of white oyster mushrooms (*P. ostreatus*) under various treatments with different compositions can be seen in Table 6. Table 6 shows that different substrate compositions significantly affected the average stipe length of white oyster mushrooms (*Pleurotus ostreatus*). The mean separation test indicated significant differences among treatments, as reflected by the different letter groupings assigned to each treatment mean. The longest average

stipe length was observed in treatment K2 (30% sawdust + 40% corn cobs + 30% rice husks), which produced a mean stipe length of 13.38 cm and was assigned the notation "c". This value was significantly higher than that of K0 (9.308 cm; notation "a"), indicating that increasing the proportion of corn cobs in the substrate enhanced stipe elongation. Treatment K3 (30% sawdust + 30% corn cobs + 40% rice husks) resulted in an average stipe length of 12.78 cm and was categorized as "bc", suggesting that it was statistically comparable to K2 but tended to produce longer stipes than K0. Treatment K1 (40% sawdust + 30% corn cobs + 30% rice husks) yielded an intermediate stipe length of 11.68 cm and was assigned the notation "abc".

The shared letter groupings indicate that K1 did not differ significantly from the other treatments. In contrast, the shortest stipe length was recorded in K0, which consisted of equal proportions of sawdust, corn cobs, and rice husks, producing an average stipe length of 9.308 cm. The superior performance of K2 may be attributed to the higher proportion of corn cobs, which provide abundant lignocellulosic materials that serve as carbon and energy sources for fungal growth. Adequate nutrient availability in the substrate can promote mycelial activity and support the development of larger fruiting bodies, including increased stipe elongation.

**Table 6.** Average data on stipe length of white oyster mushrooms (*Pleurotus ostreatus*)

Treatment	Average stipe length (cm)
K <sub>0</sub> = 33.33% + 33.33% + 33.33%	9.308 <sup>a</sup>
K <sub>1</sub> = 40% + 30% + 30%	11.68 <sup>abc</sup>
K <sub>2</sub> = 30% + 40% + 30%	13.38 <sup>c</sup>
K <sub>3</sub> = 30% + 30% + 40%	12.78 <sup>bc</sup>

Note: Numbers in the same column followed by the same letter indicate no significant difference based on Duncan's test at a 5% significance level

The results summarized in the four tables indicate that treatment K2, consisting of 30% sawdust, 40% corn cobs, and 30% rice husks, provided the most favorable substrate composition for white oyster mushroom growth. This treatment consistently produced superior performance across several growth parameters, including stipe length, pileus diameter, total mass, and number of fruiting bodies. A comparative evaluation of all parameters that peak performance across treatments occurred in K<sub>2</sub>. This treatment contained the highest proportion of corn cobs (40%), implying that corn cobs contribute favorable characteristics that enhance the growth performance of white oyster mushrooms.

## DISCUSSION

An analysis of how substrate composition influences stipe length, pileus diameter, mass, and number of fruiting bodies showed that is observed in K<sub>2</sub> this suggests that corn cobs contribute significantly to all parameters. Across all growth parameters, K<sub>2</sub> (30% sawdust, 40% corn cobs, 30% rice husks) shows the best results, indicating that corn cobs play a crucial role in enhancing growth and productivity. K<sub>3</sub>, with 40% rice husks, shows reduced values across all metrics compared to K<sub>2</sub>. While rice husks still contribute to growth, they appear less effective than corn cobs as the dominant substrate. K<sub>0</sub> shows the lowest values in all parameters, suggesting that an equal mix of substrates does not provide the optimal balance of nutrients or structural conditions for growth. K<sub>1</sub>, with 40% sawdust, shows moderate results across all parameters, suggesting that sawdust contributes positively but is not as effective as corn cobs when used in higher proportions.

The successful cultivation of white oyster mushrooms (*Pleurotus ostreatus*) relies heavily on the composition of the substrate, which provides essential nutrients for fungal growth and fruiting body development. Sawdust, corn cobs, and rice husks are commonly used as base materials for mushroom cultivation due to their rich composition of cellulose, hemicellulose, lignin, and essential minerals. Cellulose and hemicellulose are primary energy sources for mycelium growth.

White oyster mushrooms are lignocellulolytic fungi, meaning they break down plant-based materials containing cellulose and hemicellulose into simpler sugars, which serve as their primary energy source. Sawdust contains high levels of cellulose and hemicellulose (approximately 60–70%), making it an excellent carbon source that supports rapid colonization by mushroom mycelium (Fritz et al., 2025; Miah et al., 2017). Corn cobs also contribute important structural carbohydrates, with

about 33.7% cellulose and 31.9% hemicellulose, which help provide a steady release of nutrients and promote strong mycelial expansion (Yusal & Nur, 2023; Zou et al., 2021). In addition, corn cobs contain small amounts of nitrogen that contribute to the nutritional balance of the substrate and help regulate the carbon-to-nitrogen (C) ratio, an important factor affecting mycelial growth and mushroom productivity (Suwannarach et al., 2022; Doroški et al., 2022). Similarly, rice husks supply additional cellulose (approximately 35.6%) and hemicellulose (about 18.4%), thereby increasing carbon availability for fungal metabolism and biomass accumulation during mushroom growth (Muthmainnah & Idris, 2025; Gao et al., 2018). Although rice husks are relatively low in nitrogen, their incorporation into substrate formulations can improve the physical structure and contribute to maintaining an appropriate C ratio when combined with other lignocellulosic materials, thereby enhancing the growth and yield of *Pleurotus ostreatus* (Suwannarach et al., 2022; Silva et al., 2024).

This balanced availability of carbon-rich compounds ensures that the mushrooms have a sustained energy supply throughout their growth cycle, leading to higher yield and larger fruiting bodies. Lignin degradation is enhanced mushroom development. Lignin is a complex polymer that provides structural rigidity to plant materials. White oyster mushrooms produce lignin-degrading enzymes (laccases and peroxidases) that help them break down these tough materials, releasing additional nutrients needed for fruiting body formation (Bonner, 2021)

The term "Nitrogen-Free Extract" (NFE) refers to the carbohydrate portion of a substrate, encompassing sugars, starches, and other soluble carbohydrates. In the context of corn cobs, an NFE content of 60.9% indicates a high level of these carbohydrates, which are crucial for the growth of White Oyster Mushrooms (*P. ostreatus*). Study by Zhiqiang et al. (2018), investigated the cultivation of *P. ostreatus* on corncob substrates supplemented with various herb residues. The research found that the carbohydrate content of the substrate significantly influenced mycelial growth and mushroom yield. Specifically, substrates with higher carbohydrate availability supported more robust mycelial colonization and increased fruiting body production. This finding aligns with the understanding that the high NFE content in corn cobs provides an abundant source of readily metabolizable carbohydrates. These carbohydrates serve as a primary energy source for the mushroom's metabolic activities, thereby enhancing growth and yield. In summary, the substantial NFE content in corn cobs offers a rich supply of soluble carbohydrates, which are essential for the optimal growth and development of white oyster mushrooms (Alqaisi et al., 2022)

Rambey et al. (2019) examined the productivity of *P. ostreatus* cultivated on media composed of corncobs mixed with sawdust. The researchers tested six different treatments with varying percentages of corncob addition: 0; 10; 20; 30; 40; and 50%. They found that the optimal growth and productivity were achieved with a 30% corncob addition. This specific composition provided lignin, cellulose, and hemicellulose levels that were most conducive to the mushroom's development (Rambey et al., 2019). Another study, published in 2023, explored the effectiveness of different media compositions—specifically wood sawdust, rice bran, and corn flour—on the growth of white oyster mushrooms. The research utilized a completely randomized design with five treatments, each with varying ratios of the three components. The findings indicated that the composition of the growing media significantly influenced various growth parameters, including the initiation of mycelium growth, the time required for mycelium colonization, the number of fruiting bodies, cap width, dry weight, and moisture content. The most effective media composition was found to be 55% wood sawdust, 25% rice bran, and 20% corn flour, which accelerated the growth of white oyster mushrooms (Finmeta et al., 2023).

These studies corroborate the conclusion that specific substrate compositions, particularly those incorporating corncobs or other corn-derived components, can significantly enhance the growth and productivity of white oyster mushrooms (*P. ostreatus*). Corncobs contribute substantial amounts of cellulose and hemicellulose that serve as carbon sources for mycelial growth, while also improving substrate porosity and aeration. In the present study, environmental conditions within the incubation room were maintained at a temperature range of 22–28 °C and a relative humidity of 60–70%, providing favorable conditions for mycelial colonization of the substrate. These environmental conditions likely supported the efficient degradation of lignocellulosic materials by fungal enzymes

and facilitated nutrient uptake by the developing mycelium. Consequently, the positive effects of substrate compositions containing higher proportions of corncobs may have been enhanced under these suitable incubation conditions, allowing the mycelium to fully exploit the available nutrients. Therefore, the observed improvement in mushroom growth and productivity can be attributed not only to the nutritional characteristics of the substrate but also to the interaction between substrate composition and environmental factors that collectively promote optimal mycelial development and subsequent fruiting body formation.

## CONCLUSION

The results clearly indicate that K2 (30% sawdust, 40% corn cobs, 30% rice husks) provides the most favorable substrate composition for white oyster mushrooms, maximizing stipe length, pileus diameter, mass, and the number of fruiting bodies. The dominant presence of corn cobs appears to be the critical factor for enhanced growth and productivity. Future cultivation strategies should prioritize optimizing corn cob content while maintaining adequate proportions of sawdust and rice husks to achieve the best outcomes.

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