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Optimization of Oyster Mushroom Dough Mixing Machine Using Omron CP1E PLC Control

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ABSTRACT

Oyster mushroom cultivation is vital for providing the growing medium. Manually mixing the growing medium has several limitations, including time-consuming and inconsistent results. This paper objectives are to resolve growing medium oyster mushroom with mixing machine based on the Omron CP1E Programmable Logic Controller (PLC). The research methodology of mechanical and electrical of the machine was equipped with a single-phase AC motor, relay, control panel, and PLC-based control system to increases labor efficiency and ensures uniformity in the media mixture. This paper contribution research are to find the best composition of ingredients with PLC control to get homogenous media mixture by measuring the weight of the ingredients, mixing time, power consumption, and the homogeneity of the mixture. Based on the test results, the prototype is able to pack oyster mushroom growing media close to the initial mass, which is around 2975–3015 grams with an error of 1%, as well as decreasing power consumption due to the growing media mixture starting to become homogeneous so that the motor works lighter. The prototype of the oyster mushroom mixing machine has been successfully mix the media homogenous in 3minutes with the motor speed 70 rpm and power consumption 345 Watt.

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1. INTRODUCTION

Oyster mushrooms (Pleurotus ostreatus) are a type of edible mushroom that has high economic value and is rich in nutrients such as protein, fiber, and vitamin B[1]. Besides being easy to cultivate, oyster mushrooms have a delicious flavor and a texture similar to meat, making them a popular healthy food alternative. The demand for oyster mushrooms continues to rise, along with growing public awareness of the health benefits of ant-based foods[2]. Manual mixing of planting media ingredients is often an obstacle in large-scale production because it is inefficient and yields an inhomogeneous mixture. Therefore, technological innovations such as a planting media mixing machine are needed to speed up the production process and maintain the consistency of the planting media. This machine can help oyster mushroom farmers improve work efficiency and production quality[3]. Oyster mushroom planting media is a planting medium used to grow oyster mushrooms. This medium is made from sawdust mixed with other materials, such as bran, corn flour, lime, and water; the sawdust is usually derived from hardwoods such as sengon or mahogany. This mixture is then compacted and placed in

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sterile plastic bags. After that, the planting media are sterilized to kill organisms that can interfere with mushroom growth. After sterilization, the mushroom spawn is planted into the oyster mushroom growing medium [4,5]. The growing medium is then stored in a humid, temperature-controlled environment suitable for oyster mushroom growth. A good growing medium will produce high-quality oyster mushrooms that can be harvested multiple times until the medium is exhausted.

To make oyster mushroom growing medium, a press machine is needed to compress the mixture to an appropriate density, neither too dense nor too soft (28–29%)[6,7]. A PLC allows for precise adjustment of raw material dosages (sawdust, rice bran, lime, etc.). The PLC can be programmed to automatically control the speed and duration of mixing the raw materials, resulting in a homogeneous, uniform mixture, which is essential for uniform mushroom growth. By using a PLC, oyster mushroom growing medium producers can increase production efficiency, produce growing medium with consistent quality, and reduce operational costs, making the PLC the right choice for oyster mushroom growing medium mixing machines[8].

2. RESEARCH METHOD

The design process begins with the design of the desired tool. The next step is the manufacturing process, which involves constructing the frame of the oyster mushroom growing media mixer according to the predetermined design, followed by assembling the electrical circuit to meet the requirements. If the tested circuit does not work, repair it by reassembling it until it does. If the assembled circuit works well, proceed to the next stage: data collection and processing, and finally, report preparation.

2.1. Block Diagram

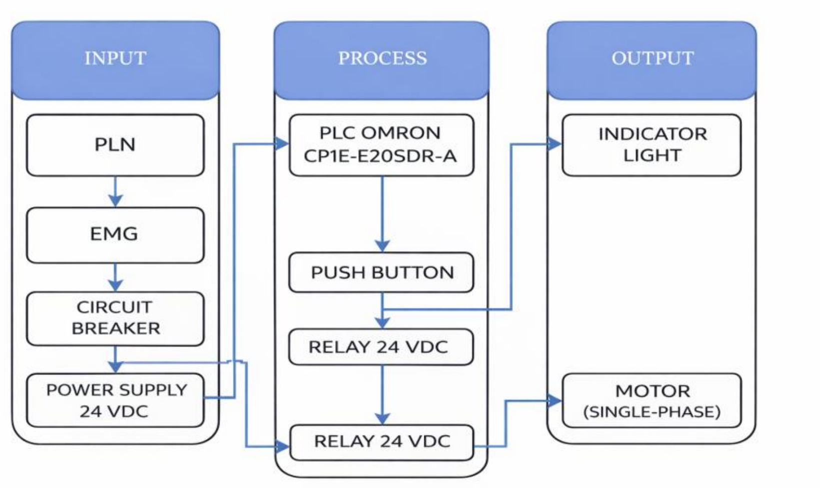

Figure 1. Block diagram

In Figure 1, the block diagram of the PLN energy source control system for the oyster mushroom growing media mixer machine begins with the main PLN electricity source, which powers the AC electric motor. This electrical power is then distributed to various components in the panel. From the panel, the outputs of these components are connected to a power supply that converts the voltage to supply other electrical components that require a lower voltage, such as the PLC. In this system, the Omron CP1E PLC requires a 24 VAC input, so a power supply is required. After that, the PLC will process data from the ladder diagram to control the AC electric motor as needed.

2.2. Flowchart

The process begins with preparing the ingredients for oyster mushroom growing media, as shown in Figure 2. The operator prepares ingredients such as sawdust, bran, lime, and water according to the measurements, then adds them one by one into the mixing machine tube[9]. After all the ingredients are added, the mixing machine starts automatically and runs for 120 seconds (2 minutes) to ensure homogeneity. In the middle of the process (at the 60th second), an alarm will sound as a halfway indicator, providing the operator with information. After 120 seconds, the valve at the bottom of the mixing machine opens automatically. The perfectly mixed dough will fall onto the turntable or container

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for further processes such as printing or packaging. After the valve opens, the mixing machine continues to rotate for 60 seconds to ensure no dough remains, and it is ready to be repeated for the next batch.

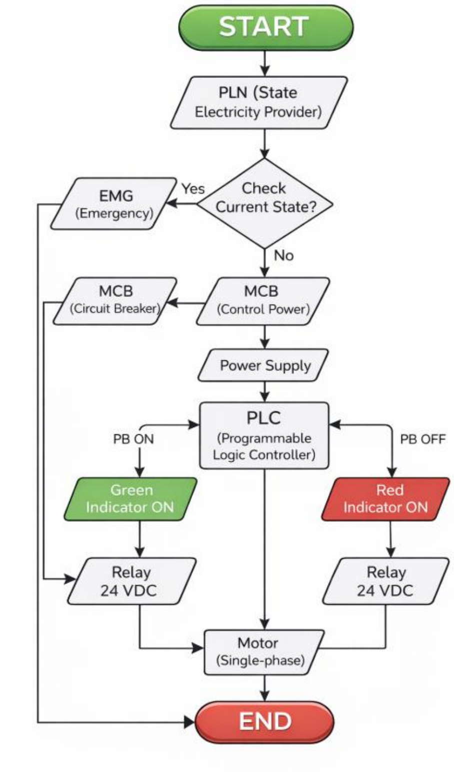

Figure 2. Flowchart system

2.3. Prototype Design

The prototype oyster mushroom media mixer machine is equipped with mechanical and electrical designs based on the CP1E-E20SDR-A control. The mechanical design uses SolidWorks software to determine dimensions and requirements, as shown in Figure 3. The mechanical design of the oyster mushroom media mixer machine consists of an electric motor, V-belt drive, gearbox, primary and secondary gears, press bars, stopper, printing plate, and electrical panel box.

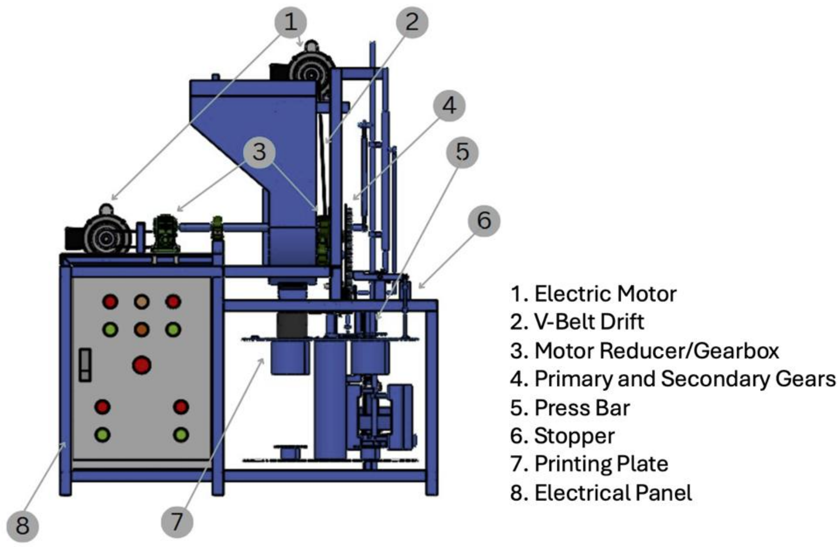

Figure 3. Mechanical design

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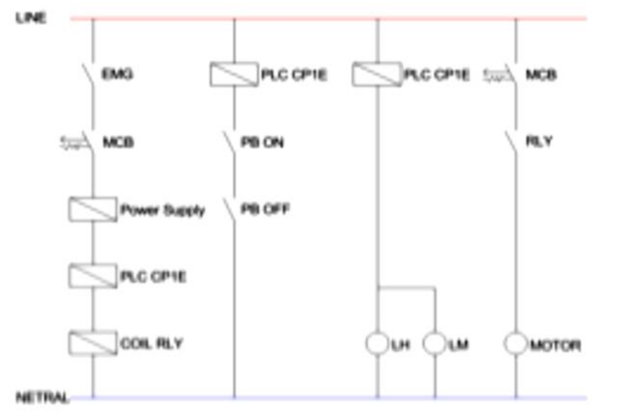

Figure 4. Control wiring installation

Figure 4 shows a diagram of a PLC-based control system installation. From the PLN (State Electricity Company) source, electricity flows to the MCB (Miniature Circuit Breaker) and then to the Power Supply. From the Power Supply, the DC power flows to the PLC I/O terminals and indicator lights. A ground is connected from the Power Supply to the PLC and other circuit components. For equipment requiring a 220 V supply, an AC neutral line is used.

The automated system for the oyster mushroom growing media mixer is powered by a 220 V supply from the PLN, protected by an MCB. The Power Supply converts the 220 V AC power to 24 V DC. The Power Supply powers the PLC and other control components. The operator presses the start and stop buttons. The PLC then processes the signals according to the ladder diagram. The resulting output is sent to the indicator lights and motor, which then illuminate according to the process conditions. This device is also equipped with an MCB and grounding to protect the system from electrical hazards.

3. RESULTS AND DISCUSSION

Figure 5(a) shows the main frame of the machine, which is made of 40x40 mm hollow iron, with the mixing container or tube being a 3 mm-thick stainless steel plate with a capacity of about 5 kg , used to mix planting media materials such as sawdust, bran, lime, and water. For the drive, a 0.5 HP motor is installed to rotate the stirrer via a pulley and a reducer gearbox with a 1:20 reduction[10], [11]. This machine is designed to mix planting media such as sawdust, bran, and lime homogeneously at adjustable stirring times and speeds, with the capacity of each bag is 1 kg as shown in Figure 5(b). The PLC system serves as a control center, regulating the drive motor and stirring duration according to a predetermined program, enabling the mixing process to run automatically and consistently. This machine is equipped with the main components: a single-phase AC motor, a relay, and a control panel, which support efficient and safe operation. With a PLC-based control system, this machine not only increases time and labor efficiency but also ensures uniformity in the planting media mixture, which is optimal for oyster mushroom growth. In addition, safety features are included to minimize the risk of accidents during the mixing process [12].

(a) (b)

Figure 5. Oyster mushroom mixer machine prototype

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3.1. Electrical and Automation Design

The electrical system for the oyster mushroom growing media mixer is designed to control the mixing process automatically and more efficiently. Using the Omron CP1E PLC as the main control enables the system to operate according to the program and with high precision, thereby reducing human error and increasing the speed of growing media production. Before implementation in the tool prototype, configuration, control, automatic circuits, and ladder programming for the Omron CP1E PLC were carried out using the CX-Programmer software [13]. The goal is to create a simulation of a control logic circuit that regulates the working sequence of components, such as motors and indicator lights, that show the on/off status of the Omron CP1E PLC. The Omron CP1E PLC circuit can be used in two modes, namely Manual Mode. The operator can turn the motor on and off directly using the on/off push button. Meanwhile (Automatic Mode), the PLC can execute automatic logic, such as mixing time, pauses, and motor working sequence, according to the ladder program [14].

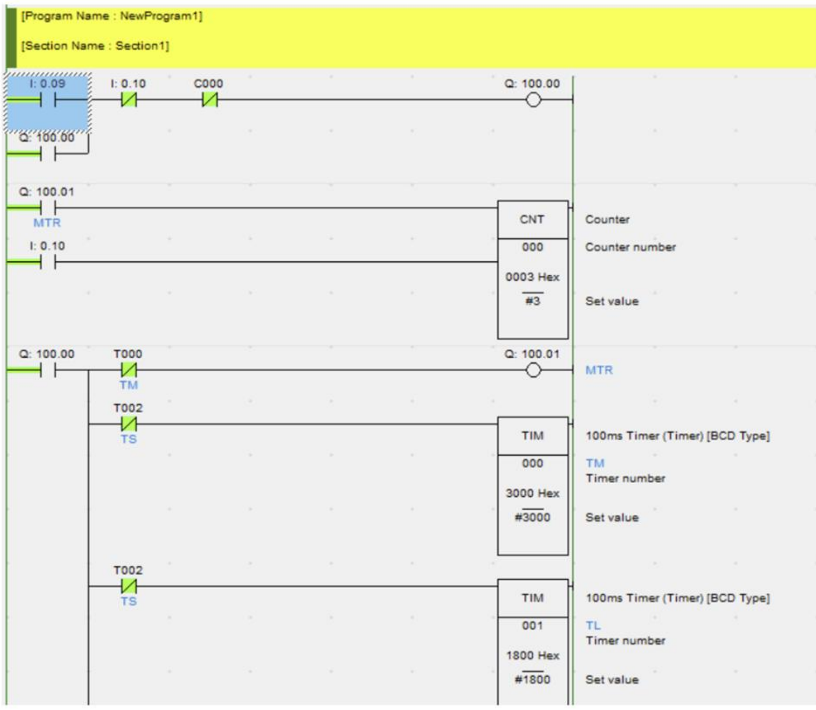

Figure 6. Ladder diagram of PLC

The PLC ladder diagram in Figure 6 shows a system ready to operate upon receiving the initial input. A combination of counters and timers controls the process, limiting the number of cycles and regulating the working time and pauses between cycles. Using a latch, counter, and two sequential timers, the system can run automatically and regularly, stopping after reaching a predetermined number of repetitions, thereby making it efficient and meeting process requirements [15]. When the mixer control alarm sounds, the mixer timer (T001) triggers an active interlock, which activates the press machine control program, as indicated by an NC contact (I:0.08) and a green line showing the contact is connected. The press machine can be activated at any time by pressing the on button. The ladder diagram in the ON/active state shows that the system operates automatically and is structured according to the timers' time sequence. Timers T0, T1, and T2 regulate the working duration of each process, while outputs Q100.01 to Q100.04 are activated sequentially. After all stages are completed, the process will return to the beginning via trigger T002, allowing the system to run repeatedly and efficiently according to the predetermined working cycle.

3.2. Testing of Material Mixture

Testing the oyster mushroom growing medium includes several parameters. The following are raw material parameters. The first parameter is raw materials, including weighing and mixing sawdust, bran,

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lime, and water according to the specified measurements. The second parameter is material mixing, which is performed to assess the mixture's homogeneity, both visually and by sampling several points. The third parameter is mass and power, which measure the mass of the processed material and the electrical power consumed during the process, respectively, to assess the machine's efficiency. The last parameter is Initial and Final Mass Error, which compares the mass before and after mixing to determine the level of material loss during the process.

Table 1 presents the test results for the material mixing process using a mixer at a constant rotation speed of 70 rpm and a mixed mass of 3 kg. The test was conducted three times, with each trial having a different process duration: 1 minute, 2 minutes, and 3 minutes. The parameter observed at each process time was the quality of the mixing results, which was categorized into three levels: inhomogeneous, fairly homogeneous, and homogeneous.

In the first trial, mixing results at 1 and 2 minutes showed inhomogeneity, but after 3 minutes, the mixing quality became fairly homogeneous. Similarly, in the second trial, mixing remained inhomogeneous for the first minute but became fairly homogeneous at the 2nd and 3rd minutes. In the third trial, the improvement was more notable. In the first minute, results were still inhomogeneous; by the second minute, they were nearly homogeneous; and in the third minute, the mixing quality had achieved a homogeneous level.

Table 1. Material mixture test data

No of Experiment	Speed (Rpm)	Mass (Kg)	Time (Minutes)	Quality
1	70	3	1	not homogeneous
			2	not homogeneous
			3	almost homogeneous
2	70	3	1	not homogeneous
			2	almost homogeneous
			3	almost homogeneous
3	70	3	1	not homogeneous
			2	almost homogeneous
			3	homogeneous

3.3. Electrical power usage testing

Based on the data in Table 2, the results of testing the Omron CP1E PLC-based oyster mushroom growing media mixer machine under two conditions: no-load and loaded. The first to third columns show the parameters for no-load conditions, while the fourth to seventh columns show the parameters when the machine is loaded with a dough mass of 3000 grams. Meanwhile, under loaded conditions with a dough weighing 3000 grams, the rotational speed is maintained at 70 rpm, but the electric current increases consistently to 1.7 A for each test. The required power is also higher, ranging from 382 to 407 Watts. This increase in power reflects the additional energy required to handle the workload during mixing.

Table 2. Electrical power usage testing

No of Experiment	On-load condition			Load-free condition		
	Speed (Rpm)	Current (Ampere)	Power (Watt)	Speed (Rpm)	Current (Ampere)	Power (Watt)
1	70	1,7	406	70	1,5	345
2	70	1,7	406	70	1,6	347
3	70	1,7	407	70	1,6	349
4	70	1,7	382	70	1,6	353
5	70	1,7	389	70	1,7	353

Based on Table 2, the test results indicate that the machine can maintain a fairly stable dough mass, despite small fluctuations between the initial and final masses. The error value ranges from 1% to 1.1%, which remains within reasonable tolerances. This mass difference is likely due to several factors, including dough residue on the tool, minor spills, humidity, and weighing variations. These results

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indicate that the mixer machine operates well and is suitable for making dough for oyster mushroom growing media.

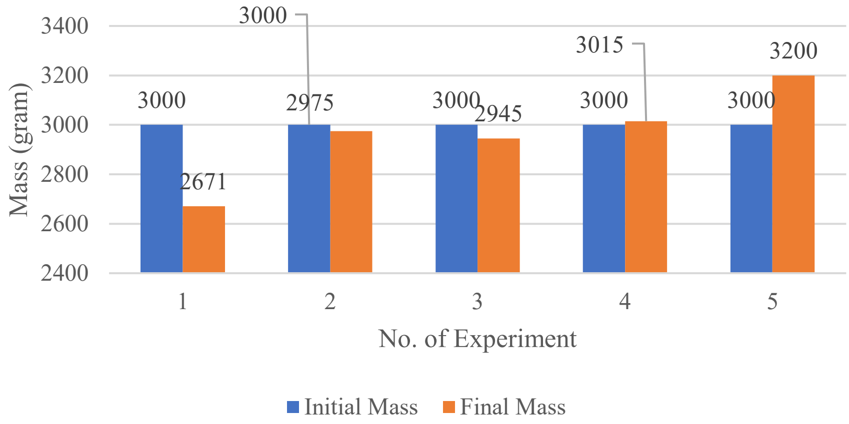

Figure 7. The mass of the planting media mixture graph

In Figure 7, the initial mass for all experiments was constant at 3000 grams. This shows that the material input was kept constant to maintain the test's validity. The final mass of Experiment 1 was lower (2671 grams), with the highest error at 1.1%. Experiments 2–4 showed a final mass close to the initial mass, ranging from 2975 to 3015 grams, with an error of 1%. Experiment 5 even showed a final mass greater than the initial mass (3200 grams), as the remaining dough stuck to the tool and small spills occurred.

4. CONCLUSION

The prototype of the oyster mushroom growing media mixing machine has been successfully designed with an automatic programming system using the Omron CP1E PLC, which supports a mechanical load of 3000 grams of growing media. This paper's contribution is to identify the optimal ingredient composition using PLC control to achieve a homogeneous media mixture by measuring ingredient weights, mixing time, power consumption, and the homogeneity of the mixture. Based on the test results, the prototype is able to pack oyster mushroom growing media close to the initial mass, which is around 2975–3015 grams, with an error of 1%, as well as decreasing power consumption due to the growing media mixture starting to become homogeneous, so that the motor works lighter. This research has a limitation in the value of the press mixture from the machine due to mechanical factors. To guide further research, the author suggests identifying the maximum pressure for media mixing and optimizing the packaging of oyster mushroom growing media to reduce production time. Based on the test results, the final mass in experiment 1 was lower (2671 grams), with the highest error of 1.1%. Experiments 2–4 showed a final mass close to the initial mass, ranging from 2975 to 3015 grams, with an error of 1%. The 5th experiment even showed a final mass greater than the initial mass (3200 grams of remaining dough stuck to the tool, a small spill, higher power required than without a load, which was around 406–407 watts in the 1st to 3rd tests). Power decreased to 382 watts in the 4th test and increased slightly to 389 watts in the 5th test. This decrease in power can be caused by the mixture of planting media becoming more homogeneous, so that the motor operates more lightly, or by external factors such as voltage and temperature fluctuations. In conclusion, the prototype oyster mushroom mixing machine has successfully homogeneously mixed the media in 3 minutes at a motor speed of 70 rpm and a power consumption of 345 watts.

REFERENCE

[1] N. A. Mardianti, S. Saadah, R. A. Nadja, and …, "Strategi pemasaran efektif untuk meningkatkan produksi dan pendapatan usaha jamur tiram (studi kasus PT Timur Mushroom Farm Desa

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Kuajang Kecamatan …,” *JIA (Jurnal Ilmiah* …, 2024, [Online]. Available: https://ejournal.agribisnis.uho.ac.id/index.php/JIA/article/view/965

[2] K. E. Wahyudi, M. A. Aziz, A. A. Putri, and …, “Pemberdayaan masyarakat dalam melakukan pembudidayaan jamur tiram di Desa Laweyan,” *Jurnal* …, 2023, [Online]. Available: https://azramediaindonesia.azramediaindonesia.com/index.php/abdimasberkarya/article/view/604

[3] I. Badarina, E. Sulistyowati, Z. Efendi, and …, “Pelatihan membuat bibit jamur tiram putih dari bahan lokal bersama kelompok petani pengusaha jamur di Desa Suro Ilir Kabupaten Kepahiang,” *Panrita Abdi-Jurnal* ..., 2023, [Online]. Available: http://journal.unhas.ac.id/index.php/panritaabdi/article/view/18711

[4] N. A. Pratiwi, H. Alfi, B. Warman, and E. Syafri, “Review Media Tanam dan Hasil Jamur Tiram putih (Pleurotus ostreotus),” *Agroteknika*, 2025, [Online]. Available: https://agroteknika.id/index.php/agtk/article/view/476

[5] N. A. Elhany, D. Indriyani, C. Handayani, and ..., “Pelatihan Pembuatan Produk Jamur Tiram Sebagai Upaya Untuk Meningkatkan Pendapatan Ibu-Ibu PKK Paaraman Kelurahan Dawuhan Kabupaten Situbondo,” *GUNAVATTA: Jurnal* ..., 2025, [Online]. Available: https://unars.ac.id/ojs/index.php/GUNAVATTA/article/view/6872

[6] M. Risal and A. Firmanzah, “Pelatihan Budidaya Jamur Tiram Untuk Mendorong Minat Berwirausaha Bagi Mahasiswa Magister Manajemen Universitas Muhammadiyah Kalimantan Timur,” *Jurnal Abdimas Sang Buana*, 2024, [Online]. Available: https://jurnal.usbypkp.ac.id/index.php/Abdimas_Sang_Buana/article/view/3541

[7] Y. Mulyanto, F. Idifitriani, E. S. Susanto, and S. Sulastri, “Implementasi Sistem Monitoring Berbasis Internet Of Things (IoT) pada Rumah Budidaya Jamur Tiram,” *Digit. Transform. Technol*, 2024.

[8] B. J. Tiram, *Budidaya Jamur Tiram Dalam Upaya Peningkatan Pendapatan Keluarga Di Nagari Tanjung Alai*. pdfs.semanticscholar.org, 2023. [Online]. Available: https://pdfs.semanticscholar.org/2901/fa53aa42f9fb5e11838ebd6dc9d5919bc456.pdf

[9] N. Kusumadewi, N. Hernita, A. Rusdiana, and ..., “Pendampingan Labeling Dan Packaging Dalam Upaya Membangun Branding Ukm Jamur Tiram Desa Ujungberung Kabupaten Majalengka,” *Bernas: Jurnal* ..., 2023, [Online]. Available: https://www.researchgate.net/profile/Alan-Rusdiana-2/publication/375575808_Pendampingan_Labeling_Dan_Packaging_Dalam_Upaya_Membangun_Branding_UKM_Jamur_Tiram_Desa_Ujungberung_Kabupaten_Majalengka/links/654f8f3ab1398a779d7d6138/Pendampingan-Labeling-dan-PA

[10] A. Anggraeni, S. Salmi, R. Robika, and ..., “Optimalisasi usaha budidaya jamur tiram di desa teru melalui kemandirian pengadaan media tumbuh dan penanaman bibit jamur,” *Jurnal Pengabdian* ..., 2023, [Online]. Available: http://jurnal.borneo.ac.id/index.php/jpmb/article/view/2998

[11] E. W. Fatmawati, I. Y. Astuti, and ..., “Pemberdayaan masyarakat melalui kewirausahaan budidaya jamur tiram sebagai sumber pendapatan alternatif,” *Jurnal Abdimas Bina* ..., 2025, [Online]. Available: http://www.jabb.lppmbinabangsa.id/index.php/jabb/article/view/1693

[12] N. A. Elhany, U. B. Husnudin, A. M. A. Nuriyante, and ..., “Sosialiasasi Budidaya Jamur Tiram dan Pelatihan Penanaman Jamur Tiram bagi BEM Fakultas Pertanian, Sains dan Teknologi Unars,” *INTEGRITAS: Jurnal* ..., 2023, [Online]. Available: https://unars.ac.id/ojs/index.php/integritas/article/view/3800

[13] A. Anugrah, G. A. Tanan, I. Jamaluddin, and ..., “Pengembangan Mesin Pencampur Bahan Media Tanam Jamur Tiram,” *Jurnal Teknik Mesin* ..., 2024, [Online]. Available: https://jurnal.poliupg.ac.id/index.php/Sinergi/article/view/4765

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ISSN 2355-5068 ; e-ISSN 2622-4852
DOI: 10.33019/jurnalecotipe.v13i1.4595

[14] I. Mayada, *Analisis Usahatani Jamur Tiram di Gampong Panggoi Kecamatan Muara Dua Kota Lhokseumawe (Studi Kasus: Usahatani Jamur Tiram Bapak Safwandi)*. rama.unimal.ac.id, 2024. [Online]. Available: https://rama.unimal.ac.id/id/eprint/617/

[15] D. Subali and A. T. Hartanti, “Pelatihan Pembuatan Bibit Jamur Tiram dan Kuping Untuk Keberlangsungan Budi Daya Jamur di Papua,” *Abdimas Galuh*, 2024, [Online]. Available: https://jurnal.unigal.ac.id/abdimasgaluh/article/view/14032