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Damper Based Tobacco Dryer for Cold Weather Areas

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ABSTRACT

The problem in this study is that the conventional tobacco drying process often experiences constraints on time efficiency and drying quality due to temperature fluctuations and noise interference from the dryer. This study aims to develop a damper-based tobacco dryer integrated into an educational physics laboratory. This tool is designed to overcome the problem of tobacco harvest quality, which is often affected by unstable weather, especially in the drying process. This study uses a development method using the 4D model (Define, Design, Develop, Disseminate) applied to ensure that the resulting tool meets the needs of tobacco farmers and can be used as a learning medium in the physics laboratory. The results of the test show that the damper-based tobacco dryer is able to increase the efficiency of the best drying process with optimal drying temperature and time, namely using 15 minutes at a temperature of 100°C and producing better tobacco quality compared to traditional methods. In addition, this tool also provides an opportunity for students to understand physics concepts related to heat and energy transfer, as well as the application of technology in agriculture. The impact of this research not only provides practical solutions for tobacco farmers, but also contributes to improving the quality of physics learning in schools. It is hoped that the results of this study can be a reference for the development of other educational tools and encourage innovation in the use of technology to support the agricultural sector.

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INTRODUCTION

Tobacco is one of the main commodities in the agricultural sector that has high economic value, especially in Temangggung Village. Tobacco commodities contribute significantly to farmers' income. In Temanggung Regency, for example, tobacco is a leading commodity that provides almost 70% of the total income for farmers. However, domestic tobacco consumption is already very large, so exports are not too large. Indonesia often has to import other tobacco commodities needed for the cigarette industry.

Tobacco in certain villages in Temanggung Regency has unique quality specifications and high value. For example, "mutu srinthil" from Temanggung is known for its high quality and fantastic price, reaching millions of rupiah per kilogram. Tobacco cultivation in Temanggung Regency not only provides direct benefits to farmers but also supports various supporting

industries such as the tobacco shredding processing industry and other supporting material industries.

The trade sector has also grown rapidly through trade activities on both small and large capital scales, including warehousing and freight transport activities. However, tobacco is also not free from challenges and threats, such as the anti-smoking movement pioneered by WHO in 1974 and the raising of the "Framework Convention on Tobacco Control" (Maulisza, 2023). Tobacco is one of the main commodities in the agricultural sector that has high economic value, especially in Temanggung Village (Kusnianto et al., 2018). Its existence not only contributes to farmers' income but also supports various economic and social aspects in the area. Despite the challenges, tobacco will continue to be an important commodity in the local economy (Hikmah, 2025).

Tobacco farmers in Temanggung are highly dependent on the dry season, especially in the process of drying tobacco leaves. The dry season provides ideal conditions for drying, where sufficient sunlight helps speed up the process and improve the quality of tobacco leaves (Arifandi et al., 2018). This is in line with the experience of farmers in other areas, such as Lumajang, where hot weather during the dry season produces better quality tobacco and increases farmers' income by up to 70%. However, Temanggung is located in Central Java with a cool climate and high rainfall. These conditions make it difficult for farmers to obtain optimal tobacco quality. When it rains, the drying process is hampered, and tobacco leaves exposed to water can experience a significant decline in quality. Experience shows that tobacco exposed to rain usually has a lower selling price (Septiadi et al., 2021).

To overcome this problem, farmers often have to spend additional costs to use alternative or traditional drying systems. For example, some farmers use drying rooms with the help of additional heat sources to ensure that the tobacco leaves dry evenly and quickly. Although this method can improve quality, the operational costs are quite high and can reduce farmers' profits. Unpredictable weather conditions have a direct impact on the economy of farmers. When the rainy season comes early or is prolonged, many farmers experience losses due to poor harvests (Lusiana, 2024). The decline in quality also has an impact on low tobacco selling prices, making it difficult for farmers to get adequate profits (Yaqin et al., 2025).

This study developed a hybrid tobacco drying machine that utilizes solar heat and biomass combustion (Yaqub, 2019). This machine is designed to increase the efficiency of tobacco drying by utilizing alternative heat sources, and the results show a significant reduction in water content within a certain time. This study focuses on the manufacture of a shredded tobacco dryer using an electric heater based on the ATMega 8535 microcontroller. This tool is equipped with a temperature sensor and load cell to monitor the drying process automatically, providing a solution for farmers who still use traditional methods.

Different from previous studies that used more heat sources from biomass or gas (Mahartika et al., 2024), and did not integrate the concept of dampers to maintain optimal temperatures. Meanwhile, this study attempts to fill the gap between existing tobacco drying technology and new innovations in the use of electric ovens as drying tools. By considering the local context and the needs of farmers, this study is expected to provide practical and efficient solutions in the tobacco drying process, while increasing public awareness about the use of kitchen tools for agricultural purposes.

So from the existence of this problem we will try to make a damper-based tobacco dryer that we innovate from an electric oven. This aims to motivate the public that the oven that we usually use to make bread is not only used in the kitchen, but can also be used by the community, especially for tobacco farmers as a more sophisticated tobacco dryer. Research on damper-based tobacco dryers aims to overcome the problems faced by tobacco farmers related to the quality of the harvest which is often affected by unstable weather. By utilizing a modified electric oven, this tool is designed to provide a more optimal and efficient drying solution. The main objective of this research is to ensure that the tobacco drying process can be carried out consistently, thus producing better tobacco quality and reducing farmer complaints about less than optimal harvests.

The contribution of this research is very significant in the context of modern agriculture. With the innovation of a damper-based tobacco dryer, farmers no longer depend on the dry season to get good results. This tool allows drying to be done at any time, regardless of weather conditions, thereby increasing farmer productivity and income. In addition, by introducing the use of electric ovens in agriculture, this research also contributes to increasing public awareness of the use of technology in the agricultural sector, encouraging the adoption of more advanced agricultural practices. Overall, this research not only focuses on the technical aspects of the drying device, but also has a broad social impact. By providing concrete solutions to the problem of tobacco drying, it is expected to improve the welfare of farmers and encourage local economic growth. In addition, this research opens up opportunities for further innovation in agricultural technology, with the potential to be applied to other commodities that face similar challenges in the drying process.

METHODS

This study uses a quantitative approach with an experimental method (Anam et al., 2023; Zulfikar et al., 2024). The quantitative approach was chosen because it is suitable for testing hypotheses and measuring the effect of certain treatments on other variables under controlled conditions (Waruwu et al., 2025). In the context of this study, an experimental approach was used to measure the effectiveness of a damper-based tobacco dryer designed using an electric oven. The reason for choosing this method is because experiments help researchers to directly observe the impact of the treatment given to the object being studied (Yuliani & Supriatno, 2023), in this case the tobacco drying process, so that the results obtained can be translated into objective numbers.

The research design used in this study was a quasi-experiment with a comparative approach. Researchers compared the results of tobacco drying using a new electric oven-based tool with the results of drying using conventional methods. This design was chosen because it allows for special treatment in the experimental group without having to eliminate the control group using the old method. With this design, researchers can find out the extent to which the new tool is effective compared to previous methods in terms of quality and drying time of tobacco.

The research instruments used include an electric oven-based tobacco dryer as a treatment variable, as well as a temperature and humidity measuring device, and a digital scale to record changes that occur during the drying process. In addition, observation sheets and measurement records were also used to document quantitative data from both drying methods. These instruments were prepared to obtain valid and reliable data on the efficiency of the device and the quality of the dried tobacco results.

The data analysis techniques used in this study are descriptive and inferential statistical analysis. Descriptive analysis is used to describe the tobacco drying results data from both methods, such as the average drying time and tobacco water content. While inferential analysis, especially the t-test, is used to determine whether there is a significant difference between the drying results with the new tool and the conventional method. This technique helps researchers in concluding the effectiveness of the drying tool scientifically and objectively based on the data collected.

RESULTS AND DISCUSSION

The developed damper-based tobacco dryer has the main advantage of consisting of a heat damper that can act as a temperature controller to help maintain the temperature in the oven so that the temperature can be distributed evenly and prevent the tobacco from burning or scorching quickly which can damage the quality of the tobacco. The heat damper is designed to minimize the loss of heat energy so that the temperature in the drying oven is more uniform and constant. This consistency is very important when drying tobacco. Temperature instability can cause uneven drying, damage to the structure of the tobacco leaves, and undesirable color changes.

The tobacco drying experiment using *a damper-based tobacco dryer* was conducted several times. The results of the experiment are as follows.

Table 1. Experiment Results Table with Time Variations

No	Temperature (c)	Trial time (minutes)	Leaf color	Texture	Scale
1	70	10	Very green	Very soft	1
2	70	12	Greenish	A little soft	2
3	70	15	Striped	A little dry	4

Based on Table 1, namely the experiment with time variations, the first result was obtained with a temperature of 70 (c) and a time of 10 minutes, the leaf color was still very green and the texture was very soft, indicating a scale of 1. The second experiment with a temperature of 70 (c) and a time of 12 minutes, the leaf color was greenish and the texture was soft, indicating a scale of 2. The third experiment with a temperature of 70 (c) and a time of 15 minutes, the leaf color was mottled and the texture was slightly dry, indicating a scale of 4.

Too short a heating duration is not effective because the water content is still high and the color remains green, while a longer duration can reduce the water content evenly and improve the texture quality (Asiah, 2023). In addition, Sari et al. (2020) emphasized that the combination of temperature and time greatly determines the final result of leaf drying, especially in maintaining chlorophyll content and leaf structure. Thus, it can be concluded that a heating time of 15 minutes at a temperature of 70°C showed the best results in this experiment, although further testing of the chemical content and preservation effectiveness is needed to determine the optimal overall conditions. Further experiments were carried out with temperature variations. The results of the experiments with temperature variations are as follows.

Table 2. Table of Experimental Results with Temperature Variations

No	Temperature (c̊)	Trial time (minutes)	Leaf color	Texture	Scale
1	60	15	A little greenish	A little dry	3
2	80	15	Yellow	Very dry	5
3	100	15	Chocolate	Very dry	6

In the first graph, the test results show that drying time has a significant effect on tobacco maturity. In the second table, the test results show that drying temperature has a positive effect on tobacco maturity. Based on the data from the table, tobacco dried at a temperature of 60°C for 15 minutes has a slightly greenish leaf color, the texture begins to dry but still feels a bit soft (scale 3), at a temperature of 60°C for 15 minutes the leaf color begins to turn yellow, and the texture is dry (scale 5), while at a temperature of 100°C for 15 minutes the leaf color darkens to brown, the leaf texture is dry with an ideal level of stiffness (scale 6).

This finding is in line with research by (Haniati, 2021) which shows that high temperatures accelerate the drying process and affect the formation of color and final texture in tobacco leaves. Thus, both drying duration and temperature play an important role, but temperature shows a stronger influence on achieving ideal tobacco maturity (Lubis, 2017). The right combination of temperature and time is the main key to producing good quality tobacco, both in terms of color, texture, and aroma (Dellika, 2020). Increasing temperature significantly accelerates the water evaporation process and accelerates chemical reactions such as chlorophyll degradation and the formation of typical tobacco aroma compounds, which are very important in determining the final quality of the product. However, temperatures that are too high (for example above 100°C) also have the potential to damage active compounds and cause the leaves to become too brittle or even burnt. Therefore, a balance point is needed between temperature and drying time so that the results obtained are not only physically ripe, but also maintain the chemical content and characteristics of the tobacco.

CONCLUSION

Based on the research that has been conducted on damper-based tobacco dryers, several lessons can be taken as follows. Damper-based tobacco dryers are able to overcome the dependence of the drying process if the weather conditions are unstable. The results of the experiment show that the optimal temperature and drying time, using 15 minutes at a temperature of 100 °C, produces tobacco that is evenly dried and has a texture and color that meet high-quality standards. By installing a damper on an electric oven, we can stabilize the temperature in the oven. This not only increases drying efficiency, but also prevents the risk of over-drying (tobacco becomes too dry) and under-drying (tobacco is not completely dry). Consistent drying allows us to maintain the aroma, color, and texture of tobacco optimally, thus providing a competitive advantage in the market. The innovation in this tool introduces the concept of using household appliances, namely electric ovens for agricultural needs. This step shows the potential of using simple technology to support the agricultural process, while providing practical and economical end results for farmers. This tool not only helps tobacco farmers increase their harvest, but can also be applied to other raw materials. Therefore, this end contributes to increasing farmers' income

and opens up opportunities for further agricultural innovation. However, this device has limitations, one of which is the high end power consumption and limited oven space capacity. Therefore, more attention needs to be paid to the development of more efficient tools that can be used by more farmers, even in areas with limited access to electricity.

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REFERENCES

Anam, S., Nashihin, H., Taufik, A., Mubarok, Sitompul, H. S., Manik, Y. M., Suparto, Arsid, I., Jumini, S., Nurhab, M. I., Solehudin, W, N. E., & Luturmas, Y. (2023). *Metode Penelitian (Kualitatif, Kuantitatif, Eksperimen, dan R&D)*. Padang: Global Eksekutif Teknologi.

Arifandi, J. A., Wardhono, A., & Indrawati, Y. (2018). *Panduan Praktik Budidaya Tembakau Besuki Na-Oogst*. Pustaka Abadi.

Asiah, N., Sari, D. A., Triyastuti, M. S., & Djaeni, M. (2023). Peralatan pengering pangan.

Dellika Syukrina, D. E. L. L. I. (2020). *Pengaruh Suplementasi Daun Kelor (Moringa Oleifera L) Pada Keripik Pangsit Terhadap Mutu Organoleptik Dan Kandungan Zat Gizi* (Doctoral dissertation, Universitas Perintis Indonesia).

Firdaus, Fatiatun, Jumini, S., Trisnowati, E., & Dahnuss, D. (2020). Proteus as a virtual simulation to improve readiness and process skills in laboratory experiment. *Journal of Physics: Conference Series*, *1517*(1). https://doi.org/10.1088/1742-6596/1517/1/012074

Haniati, P. R. (2021). *Pengaruh Temperatur dan Kelembaban Terhadap Produktivitas Tembakau Voor-Oogst Kasturi di Kabupaten Jember* (Doctoral dissertation, Politeknik Negeri Jember).

Hermawan, H., Prianto, E., & Setyowati, E. (2014). Prediksi Kenyamanan Termal dengan PMV di SMK 1 Wonosobo. *Jurnal Penelitian dan Pengabdian Kepada Masyarakat UNSIQ*, 1(1), 13-20. https://doi.org/10.5296/ijele.v1i3.4153.

Hikmah, F. N. (2025). Tembakau Jember dalam Kerangka Teori Ketergantungan: Dinamika Ekonomi Lokal dan Pengaruh Global. *SRODJA: Sroedji Journal Administration*, *2*(1), 132-146.

Jatengprov.go.id., Portal resmi Jawa Tengah. https://jatengprov.go.id/be (Sugiyono 2019)ritadaerah/18-519-hektare-lahan-tembakau-di-temanggung-siap-dipanen/

Jumini, S. (2017). *Buku Ajar Matematika Dasar untuk Perguruan Tinggi*. Penerbit Mangku Bumi.

Kusnianto, K., Manumono, D., & Suswatiningsih, T. E. (2018). Usaha Tani Tembakau (Nicotiana Tabacum L) Di Desa Kentengsari, Kecamatan Candiroto, Kabupaten Temanggung. *Jurnal Masepi*, *3*(2).

Lubis, H. N. (2017). *Daya Saing Komoditi Tembakau Indonesia di Pasar Internasional* (Bachelor's thesis, Fakultas Sains dan Teknologi UIN Syarif Hidayatullah Jakarta).

Lusiana, E. (2024). *Analisis Fluktuasi Harga Tembakau Pada Produktivitas Petani Periode 2003-2023 Di Desa Polagan Galis Pamekasan* (Doctoral dissertation, Institut Agama Islam Negeri Madura).

Mahartika, D., Damayanti, Z., Pramudita, A. D., Adilah, B., Rahmawati, E. D., Mahmud, K., & Prihandono, T. (2024). Analisa Konsep Kalor Pada Proses Pengeringan Terhadap Kualitas Tembakau. *Jurnal Mekanova: Mekanikal, Inovasi dan Teknologi*, *10*(2), 401-409.

Maulisza, R. (2023). *Analisis Daya Saing Tembakau Indonesia di Pasar Internasional* (Bachelor's thesis, Fakultas Sains dan Teknologi UIN Syarif Hidayatullah Jakarta).

Ramadhan, D. Y., Pasaribu, L. N., & Napitupulu, J. (2024). Analisis Konsumsi Energi Listrik Pada Masjid Al-Ikhlas. *Jurnal Teknologi Energi Uda: Jurnal Teknik Elektro*, *13*(1), 39-44.

Septiadi, D., Rosmilawati, R., Usman, A., & Hidayati, A. (2021). Kelayakan Finansial Usaha Tani dan Persepsi Petani Terhadap Kebijakan Kenaikan Tarif Cukai Hasil Tembakau (Studi Kasus di Kecamatan Suralaga Kabupaten Lombok Timur). *Jurnal Agrotek Ummat*, *8*(2), 91-98.

Sugiyono. 2019. *Metode Penelitian (Kuantatitatif, Kualitatif, Kombinasi, R&D dan Penelitian Tindakan)*. Bandung.: Alfa Beta. Hal. 127.

Suwondo, A. (2014). Aplikasi Sistem Informasi Perpustakaan di SMK Takhassus Kalibeber Wonosobo. *Jurnal Penelitian dan Pengabdian Kepada Masyarakat UNSIQ, 1*(1), 31-39. https://doi.org/10.1007/s42161-018-0012-3

Taqwa, M. R. A., Priyadi, R., & Rivaldo, L. (2019). Pemahaman konsep suhu dan kalor mahasiswa calon guru. *JPF (Jurnal Pendidikan Fisika) FKIP UM Metro*, *7*(1), 56-67.

Temitope Olumide O & Oluwle Timothy O. (2018). Pengmbangan Dan Evaluasi Kinerja Lisrtik Yang Ditingkatkan Oven. *Jurnal Praktik dan Teknologi Leonardo*. hlm 191.

Ulul Albab Almujaddidy dkk. (2024). Rancang Bangun Protype Pengering Iot Untuk Meningkatkat Kualitas Tembakau Dan Menghemat Waktu Pengeringan, *Jurnal OF Social Science Research*, Vol. 4 No. 4, hlm 2.

Waruwu, M., Puat, S. N., Utami, P. R., Yanti, E., & Rusydiana, M. (2025). Metode penelitian kuantitatif: Konsep, jenis, tahapan dan kelebihan. *Jurnal Ilmiah Profesi Pendidikan*, *10*(1), 917-932.

Yaqin, A., Ridho, M. I., & Uluf, W. T. (2025). Dinamika Sosial-Ekonomi Petani Tembakau Di Indonesia: Studi Kesejahteraan Dan Keberlanjutan. *I'THISOM: Jurnal Ekonomi Syariah*, *4*(1), 574-584.

Yaqub, M. (2019). *TA: Rancang Bangun Alat Pengovenan Tembakau Otomatis Berbasis Medote Flue Curing* (Doctoral dissertation, Institut Bisnis dan Informatika Stikom Surabaya).

Yuliani, W., & Supriatna, E. (2023). *Metode penelitian bagi pemula*. Penerbit Widina.

Zulfikar, R., Sari, F. P., Fatmayati, A., Wandini, K., Haryati, T., Jumini, S., Nurjanah, Annisa, S., Budi, O., Kusumawardhani, Mutiah, R., Linggi, A. I., & Fadilah, H. (2024). *Metode Penelitian Kuantitatif*. Bandung: Widiana Media Utama.