JTEP Jurnal Keteknikan Pertanian,
Vol. 13 No. 1, p 147-161, 2025
P-ISSN 2407-0475 E-ISSN 2338-8439

Available online:
http://journal.ipb.ac.id/index.php/jtep
DOI: 10.19028/jtep.013.1.147-161

Improvement of Cured Vanilla Pod Qualities (Vanilla Planifolia A.) with a Combination of Advanced Sweating and Drying Methods

Putri Ayu Ira Distriani[1], I Wayan Budiastra[1,2*], Leopold Oscar Nelwan[1,2]

[1]Department of Mechanical and Biosystem Engineering, Faculty of Agricultural Engineering and Technology, IPB University, Lingkar Akademik Street, IPB Dramaga Campus, Babakan, Bogor, West Java 16680, Indonesia
[2]Center for Research on Engineering Application in Tropical Agriculture, IPB University, Lingkar Akademik Street, IPB Dramaga Campus, Babakan, Bogor, West Java 16680, Indonesia
*Corresponding author, email: wbudiastra@apps.ipb.com

Article Info

Submitted: 9 January 2025
Revised: 14 March 2025
Accepted: 25 April 2025
Available online: 29 April 2025
Published: March 2025

Keywords:
advanced sweating, drying, quality, vanilla pod, vanillin

How to cite:
Distriani, P. A. I., Budiastra, I. W., Nelwan, L. O. (2025). Improvement of Cured Vanilla Pod Qualities (Vanilla Planifolia A.) with a Combination of Advanced Sweating and Drying Methods. Jurnal Keteknikan Pertanian, 13(1): 18-38. https://doi.org/10.19028/jtep.013.1.147-161.

Abstract

Cured vanilla pods are raw food materials that are used as flavor and aroma agents in various foods, such as ice cream, cookies, and syrup. Cured vanilla pods are produced by farmers through long post-harvest handling, including harvesting, withering, sweating, and drying, with high variation in quality. This research aims to study the combination of advanced sweating and drying methods to improve the quality of cured vanilla pods and shorten the drying time. Approximately 33 kg of harvested vanilla pods was subjected to a withering process by soaking in hot water at a temperature of 60-65°C for 2 min, followed by a sweating process for 48 h. Subsequently, the vanilla pods were treated with three duration times of advanced sweating (4,6, and 8 days) and two drying methods (greenhouse effect/GHE solar dryer and tray dryer). These processes were continued until the water content reached 30-35%. Physicochemical measurements and organoleptic tests were carried out to monitor the quality change of the vanilla pods during the treatments. The results showed that adding advanced sweating for 4, 6, and 8 days in the drying process significantly affected the water content, color, and vanillin content of cured vanilla pods. Vanilla pods treated with advanced sweating for 8 days in the tray dryer method produced the best quality cured vanilla pods with a shorter drying time of 8 days, compared with traditional drying for 20 days and the GHE solar dryer for 10 days to reach the desired water content (35%).

Doi: https://doi.org/10.19028/jtep.013.1.147-161

1. Introduction

Vanilla fruit has a distinctive aroma, which makes vanilla-based products popular among consumers. In addition to being used as an aroma additive in food, vanilla is also used as an ingredient in cosmetics, perfumes, lotions, detergents, aromatherapy, and air fresheners (Ranchiano & Jamaludin, 2021). The concentrated vanilla extract produced from vanilla pods can also be used as a flavor source in the production of food products such as ice cream, pudding, cakes, custards, creams, and syrups.

Available online:
http://journal.ipb.ac.id/index.php/jtep
DOI: 10.19028/jtep.013.1.147-161

Based on the cured vanilla pod quality standards of Indonesia (BSN, 2002), there are several cured vanilla pod quality standards, including vanillin content and moisture content. A high quality of cured vanilla pods needs to be achieved so that cured vanilla pods from Indonesia can compete in the international market. Drying is a post-harvest process that plays a very important role in ensuring the final quality of cured vanilla pods because the drying process is fully responsible for determining the moisture content of cured vanilla pods (Amit et al., 2017). High moisture content can trigger microbial growth, including that of fungi (Ferdian et al., 2017). The decline in vanilla pod quality is caused by high moisture content, which triggers mold growth in cured vanilla pods. Many losses in vanilla pod quality occur during drying. Therefore, drying must be carried out carefully to maintain the quality of the vanilla pods and avoid drastic weight loss after drying (Gu et al., 2019). In addition to the moisture content, drying also determines the vanillin content.

In Indonesia, the drying of vanilla pods is mostly carried out by sun-drying. The quality of vanilla pods from sun drying varies according to weather conditions, takes a long time, and is subjected to exposure to dust and insects. Some alternative dryer for drying vanilla pod was assessed using a hybrid dryer, Based on the results of the research that has been carried out, it can be concluded the average final moisture content obtained in drying vanilla with solar energy for 15 days was 31.61%, drying with electrical energy for 17 days was 32.82%, and drying with solar and electric energy (hybrid) for 13 days by 32.86% (Warji et al., 2023). Another drying method uses a GHE dryer (Abdullah & Mursalim, 1997). However, the results of cured vanilla pods using a GHE dryer did not match the standard quality in terms of color and other physical criteria.

In addition to drying, sweating is also an important process that determines the quality of vanilla pods, especially the vanillin content. Traditionally, the sweating process is carried out for two days before drying. This process involved a hydrolysis process that changes glucovanillin to vanillin using ◎-glucoxidase enzyme. Therefore, a combination of proper sweating and drying methods is important for determining the quality of cured vanilla pods.

Fitriani et al., (2024) studied the postharvest method to produce a better-quality cured vanilla pod by combining advanced sweating and drying using a GHE dryer. A four-day advanced sweating using the Greenhouse Effect solar (GHE) dryer method produced better vanillin content, color, and aroma compared to the traditional method. However, there is still a possibility of improving the quality of vanilla with a longer time of advanced sweating, as Fitriani et al., 2024 reported a maximum duration of four days. However, a drying method that uses a tray dryer combined with advanced sweating has not yet been developed. Therefore, this research aims to study the combination of the duration of advanced sweating and drying methods (GHE and Tray Dryer) to improve the quality of vanilla pods and to shorten the drying time.

Available online:
http://journal.ipb.ac.id/index.php/jtep
DOI: 10.19028/jtep.013.1.147-161

2. Materials and Methods

2.1 Materials and Tools

The materials used in this study were vanilla pods of maximum harvest age (8-9 months) obtained from Sinogo, Pagerharjo, Samigaluh, Kulon Progo Regency, and Yogyakarta. Other materials used were NaOH, alcohol, and filter paper. The tools used in this research were Greenhouse Effect Solar Dryer (Abdullah & Mursalim, 1997), Tray Dryer, thermocouple type-T/0.3 mm, thermostat, thermometer with the data logger, Graphtec Midi Logger GL240, spectrophotometer, volumetric flask, Erlenmeyer funnel, digital scale, analytical scale type-PA224C Ohaus, cup, desiccator, styrofoam box, black cloth, sterile cloth, plastic, spray bottle, stove, gloves, and tarpaulin.

2.2 Research Vanilla Pod Curing Treatment

A combination of drying and advanced sweating methods was used for the vanilla pod curing treatment. Vanilla pod drying was carried out using a GHE *Solar Dryer* and *Tray Dryer* (TD) combined with advanced sweating for 4 days (4S), 6 days (6S), and 8 days (8S), resulting in six curing treatments (TD4S, TD6S, TD8S, GHE4S, GHE6S, and GHE8S) with three replicates per treatment. Before curing, the vanilla pods were sorted, cleaned, and withered at 60-65 oC for 3 min, and initial sweating was performed for 48 h. Vanilla pod curing treatments were carried out until the moisture content reached 35%. During curing, the physical and chemical properties of vanilla pods, such as color, vanillin content, and moisture content, were measured. Organoleptic tests and drying rates were also determined.

2.3 Quality Parameter Analysis

2.3.1 Color

Vanilla pod color was measured using a chromameter (CR400). The color was measured based on the values (L*, a*, and b*) (Figure 1) at three measuring points (one point at the distal part and two points at the equator of the vanilla pod). Color was measured during curing of the vanilla pods. Color is represented by L, hue, and chroma values (Irfan et al. 2023). Chroma was calculated using equation 1.

$$Chroma = (a^2 + b^2)^{1/2} \quad (1)$$

Where b* is the yellow-blue color parameter and a* is the red-green color parameter. CIELAB 1976).

$$ºHue = tan^{-1(\frac{b}{a})} \quad (2)$$

Where b* yellow-blue color parameter, a* red-green color parameter (CIELAB 1976)

Available online:
http://journal.ipb.ac.id/index.php/jtep
DOI: 10.19028/jtep.013.1.147-161

Figure 1. Color measurement of the vanilla pods.

2.3.2 Moisture content (AOAC 2005)

The moisture content was determined using the oven method (AOAC, 2005). Moisture content was measured during curing of the vanilla pods.

2.3.3 Vanillin content (AOAC, 1981)

The vanillin content of the vanilla pods was measured using a spectrophotometric method (AOAC, 1981). Vanillin tests were conducted before and after drying, using each method.

2.3.4 Organoleptic test

Organoleptic and hedonic tests of the color and aroma of cured vanilla pods were also carried out before and after treatment using 25 trained panelists (Sukarto, 1985). The initial step in panelist selection is to ensure that the panelists have good olfactory and visual conditions and do not experience any illness that could affect their assessment. After that, they were provided with education on the distinctive characteristics of the aroma and color of dried vanilla, compared with vanilla, which still has a high moisture content. Descriptive training was then conducted to describe the aroma and color using standardized terms. The evaluation was performed with three replications per sample to demonstrate the consistency of the panelists.

2.4 Drying Rate

The drying rate was calculated using Equation 3.

$$\text{Drying Rate} = \frac{\Delta W}{Wk \times \Delta t} \times 100 \quad (3)$$

Available online:
http://journal.ipb.ac.id/index.php/jtep
DOI: 10.19028/jtep.013.1.147-161

With ΔW being Changes in water weight (kg) within a certain time interval, Δt being Time change (hours or minutes) and Wk Dry weight of ingredients (kg). (Singh & Heldman, 2014).

2.5 Experiment Design and Data Processing

The research design used was a Completely Randomized Design (RAL) with two factors (length of advanced sweating and drying method) and three replicates. To determine the effect of treatment, analysis of variance (ANOVA) was conducted at a critical level of 5%, and if there were differences, it was continued with the Duncan Multiple Range Test (DMRT) using SPSS statistical analysis.

3. Results and Discussion

3.1 Vanillin Content

The results of variance analysis showed that the vanillin content parameters of vanilla pods in the tray dryer, GHE solar dryer, and advanced sweating for 4 days, 6 days, and 8 days were significantly different from the control (Table 1). The difference in vanillin content observed was due to the different sweating treatments, namely the application of 4, 6, and 8 days of advanced sweating during the drying process.

Table 1. Initial and final Vanillin content at various treatments.

Treatment	Average vanillin content before treatment (%)	Average vanillin content after treatment (%)
TD4S	0.50	1.25^{d}
TD6S	0.50	1.32^{b}
TD8S	0.50	1.48^{a}
GHE4S	0.50	1.03^{f}
GHE6S	0.50	1.2^{e}
GHE8S	0.50	1.31^{c}
CONTROL (conventional drying without advanced sweating)	0.50	0.86^{g}

Notes: Mean numbers followed by different letters in the table indicate significant differences (α = 0.05) in Tukey's further test.

Tray dryer drying with 8 days of advanced sweating treatment (TD8S) has the highest vanillin content of 1.48%. The longer the treatment time, the higher the vanillin content. The high vanillin content produced by TD8S treatment was in line with the aroma and color produced by the treatment. The aroma produced by the TD8 treatment was more robust, and the color was darker and shiny compared with the other treatments. The drying method in this study had a more dominant impact on the characteristics of the aroma profile and the glucovanilin content. The vanillin content of vanilla pods using the tray dryer method had a higher value than those using the GHE Solar Dryer and the control (traditional sun drying). This result agrees with that of Setyaningsih (2006), who stated that vanillin content depends on the sweating and drying process, extraction process, and fresh fruit raw materials used. The increase in vanillin content during the sweating process is mainly caused by the hydrolysis of glucovanillin and the accumulation of vanillin from the stages of the sweating process. A small amount of vanillin may be produced by the elimination of carbon chains from ferulic acid (Venturi et al., 1998) and methoxy-4-hydroxy benzaldehyde (Setyaningsih, 2006), as well as hydroxylation and methylation of cinnamic acid, which is a precursor of lignin. Vanillin levels can also be reduced because peroxidase enzymes oxidize vanillin to o-guaiacol or vanillic acid (Purseglove et al., 1981).

The vanilla pods at the postmortem stage produced a reasonably low vanillin content of 0.51% (Table 1). This is in line with research conducted by Odoux., 2000, which states that in the early stages of the sweating process, which includes withering and curing, only approximately 40% of glucovanillin is hydrolyzed into vanillin. This means that most glucovanilin has not yet been broken down into vanillin in these early phases. This is because at this stage, the enzymatic activity has not yet been optimal, so the hydrolysis of glucovanilin still needs time to be improved. Drying vanilla pods with a tray dryer and GHE solar dryer methods produces vanillin levels that fall into quality standard III based on the Indonesian cured vanilla pod quality standard (BSN, 2002), where this quality standard requires a minimum vanillin level of 1.00%. Meanwhile, vanilla pods dried using the control method had a low final vanillin content of 0.86%, so it has not yet to reach the required quality standard for cured vanilla.

Drying with a tray dryer produces cured vanilla pods with vanillin content that tends to be higher than that of drying with a GHE solar dryer and control. This is in line with the findings of Sumardi et al. (2001), who stated that drying vanilla pods at controlled and moderate temperatures can prevent vanillin degradation and maintain the chemical structure of vanilla pods. Drying with fluctuating temperatures, such as traditional sun drying, can cause vanilla degradation because high-temperature drying can trigger the degradation of vanilla chemical compounds or become volatile compounds that are lost during drying.

Likewise, with the results of the advanced sweating treatment, it is known that the longer the advanced sweating time, the better the quality of vanilla will tend to be, especially in vanillin content and aroma. According to Gu et al. (2019), during the aging process, glucovanillin is converted to vanillin and other aromatic compounds such as p-hydroxybenzaldehyde, vanillic acid, and phenolic compounds are increased. Curing also triggers the decomposition of cellulose, hemicellulose, pectin, and protein denaturation, reducing the stiffness of the cell wall and making the pods more elastic (flexible) (Van Dyk et al., 2010).

Available online:
http://journal.ipb.ac.id/index.php/jtep
DOI: 10.19028/jtep.013.1.147-161

3.2 Moisture Content

Tray dryer treatment with 8 days of advanced sweating (TD8S) resulted in a more significant decrease in moisture content compared to other treatments, followed by tray dryer treatment for 6 days (TD6S) and tray dryer for 4 days (TD4S) (Table 2). The Tray Dryer method has shorter drying time than other methods.

Table 2. Changes in moisture content of vanilla at various treatments.

	Drying time (days)				
Treatment	2	4	6	8	10
TD4S	72.01^{bc}	59.17^{bc}	50.88^{b}	36.16^{cd}	*
TD6S	71.42^{bc}	57.23^{bc}	46.26^{bc}	35.71^{cd}	*
TD8S	70.70^{c}	55.91^{c}	39.70^{c}	29.15^{d}	*
GHE4S	77.97^{ab}	62.86^{b}	52.67^{b}	45.90^{b}	36.16^{b}
GHE6S	73.64^{bc}	60.48^{bc}	51.72^{b}	43.11^{bc}	33.65^{bc}
GHE8S	72.58^{bc}	56.12^{c}	48.03^{b}	40.48^{c}	29.75^{c}
CONTROL	81.31^{a}	70.2^{a}	68.09^{a}	60.66^{a}	58^{a}

Notes: Mean numbers followed by different letters in the table indicate significant differences (α = 0.05) in Tukey's further test.

Simultaneously, the traditional sun drying (control) treatment experienced the lowest decrease in moisture content every day. Hence, it requires a relatively longer drying time of 20 days (140 h) compared to the tray dryer method of 8 days (56 h) and GHE of 10 days (70 h). The longer the drying time, the faster the decrease in moisture content is. This is in accordance with the research of Fitriani et al., (2024) which stated that drying vanilla with the GHE method to dry evenly with 30% moisture content is faster than the traditional method, namely for 96 hours of drying, while in this study drying vanilla to dry evenly with 30% moisture content is 70 hours shorter than traditional drying. This may be influenced by the average level of daily temperature during drying which is different and can also be influenced by the much higher level of daily solar radiation at the time of this study. Based on data obtained from the Meteorology, Climatology and Geophysics Agency (BMKG) West Java Climatology Station, it is known that during vanilla drying, the average value of daily solar radiation is quite high. Traditional sun drying conducted in this study experienced fungal contamination that affected the quality of vanilla, while the other two drying methods did not experience fungal contamination Figure 2.

JTEP Jurnal Keteknikan Pertanian,
Vol. 13 No. 1, p 147-161, 2025
P-ISSN 2407-0475 E-ISSN 2338-8439 Available online:
http://journal.ipb.ac.id/index.php/jtep
DOI: 10.19028/jtep.013.1.147-161

Figure 2. Fungal contamination 3^{th} days and 5^{th} days at control treatment with sun drying without advanced sweating.

Based on Table 1 and Table 2, it is shown that moisture content decreases during the treatment. The reduction of moisture content is primary caused by drying treatment for 7 hours per day. However, increasing of vanillin content during the treatment is mainly caused by advanced sweating process for 17 hours per day.

3.3 Color

3.3.1 L* Value

The results of variance analysis showed that the drying method significantly affected the brightness of vanilla pods (L* value). Vanilla samples dried by the tray dryer method had better results than the GHE solar dryer and traditional methods (Table 3). This is known through the decrease in L* value at four observation points, namely days 2, 4, 6, and 8, where the drying sample with the tray dryer method experienced a higher decrease in all treatments compared to other methods. The final L* value of the tray dryer method with a combination of advanced sweating for 4 days, 6 days, and 8 days are 19.95, 18.90, and 18.64 (8th day), respectively, with results that are not significantly different from each treatment. Meanwhile, drying with the GHE solar dryer method had final results of 21.73, 20.90, and 22.46 (10th day), and the control had a final value of 21.67 (20th day). The advanced sweating treatment is known to have final results of L value that are not significantly different in both the tray dryer and GHE solar dryer methods.

 Available online:
http://journal.ipb.ac.id/index.php/jtep
DOI: 10.19028/jtep.013.1.147-161

Table 3. Changes in L* value of vanilla pods at various treatments.

	Drying time (days)				
Treatment	2	4	6	8	10
TD4	27.08^{b}	22.73^{c}	20.26^{c}	19.95^{c}	*
TD6	26.26^{b}	24.54^{c}	20.23^{c}	18.90^{c}	*
TD8S	25.59^{b}	23.11^{c}	19.98^{c}	18.64^{c}	*
GHE4S	31.66^{a}	29.46^{a}	27.71^{ab}	24.59^{b}	21.73^{b}
GHE6S	31.46^{a}	29.2^{a}	26.88^{ab}	24.36^{b}	20.90^{b}
GHE8S	31.17^{a}	29.24^{a}	26.88^{b}	24.27^{b}	22.46^{b}
CONTROL	30.11^{a}	29.86^{a}	28.25^{a}	26.52^{a}	24.89^{a}

Description: Mean numbers followed by different letters in the table indicate significant differences. (α = 0.5) In (Tukey's further test.

The final L* value of the tray dryer method with a combination of advanced sweating for 4 days, 6 days, and 8 days are 19.95, 18.90, and 18.64 (8th day), respectively, with results that are not significantly different from each treatment. Meanwhile, drying with the GHE solar dryer method had final results of 21.73, 20.90, and 22.46 (10th day), and the control had a final value of 21.67 (20th day). The advanced sweating treatment is known to have final results of L value that are not significantly different in both the tray dryer and GHE solar dryer methods.

The data presented in Table 3 show that the lower the moisture content of vanilla, the darker the color of the product tends to be, as indicated by the decrease in L value (lightness) in the CIE Lab color system. The reduction in L value corresponds to the combination of advanced sweating and drying process, which induces color changes due to non-enzymatic browning reactions such as the Maillard reaction and caramelization. These reactions become more intense as moisture content decreases, especially when drying occurs at temperatures that promote interactions between reducing sugars and amino acids within the vanilla tissue. This leads to the formation of brown pigments (melanoidins), which reduce the lightness (L) of vanilla color (Syah, 2014).

In addition to color changes, reduced moisture content significantly contributes to increased vanillin content—the primary volatile compound responsible for the characteristic vanilla aroma. Lower moisture levels allow volatile compounds to be released more effectively, as they are no longer trapped in the water matrix. This results in a stronger and more distinct vanilla aroma (Dignum et al., 2001). However, prolonged drying or excessive temperatures can damage these volatile compounds, making drying conditions a critical factor in determining the final product quality.

From an export quality perspective, final moisture content is a key parameter in determining the market value of vanilla. Indonesia sets the standard moisture content for dried vanilla at 30–35%, while the United States requires a lower moisture content of 20–25%. This difference reflects consumer preferences and the intended use of the final product. Vanilla with lower moisture content typically has a longer shelf life and more intense aroma, but the drying process requires precise control of temperature and humidity to prevent aroma loss and physical damage to the vanilla pods (Ranadive, 1992).

3.3.2 Chroma Value

It was found that the drying method and advanced sweating have a significant effect on the chroma value of vanilla pods. Drying with a tray dryer produces a more intense color than the GHE solar dryer and traditional sun drying methods (Figure 3). The observations on the 8th day showed that vanilla pod samples that were further dried for 8 days were better chroma value than those that were further dried for 4 and 6 days, proving that the longer the drying time, the better the a* and b* values produced. Likewise, with the chroma value created, it is known that the drying method and advanced sweating significantly affect the chroma value of vanilla.

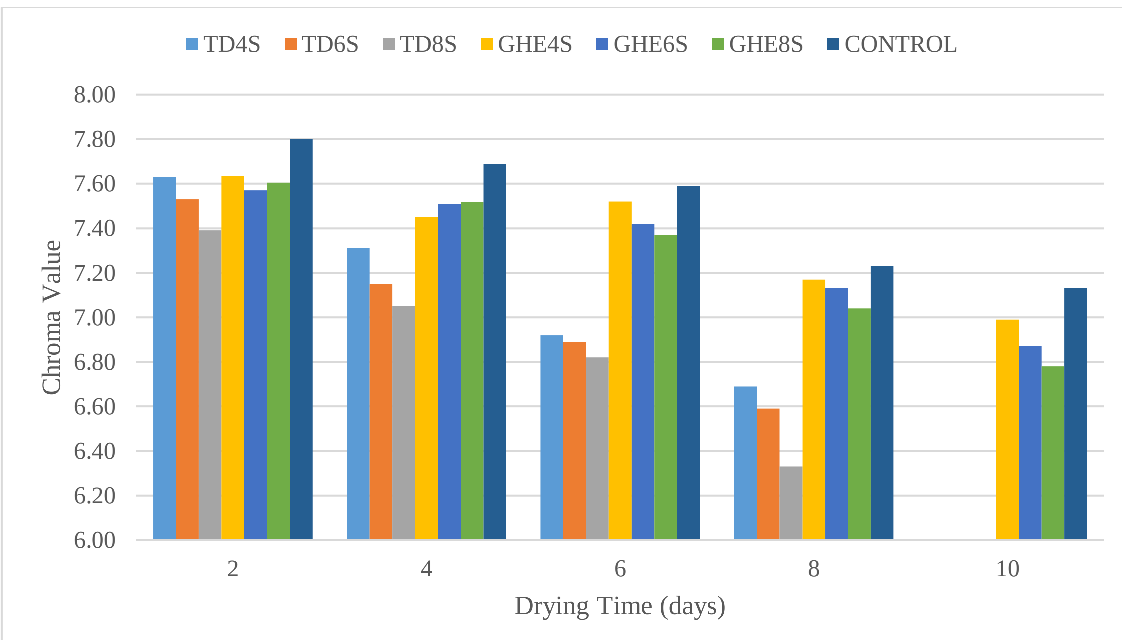

Figure 3. Changes in chroma values of vanilla pods at various treatments during drying.

The chroma value of vanilla pods decreased from fresh to cured vanilla in each treatment. Vanilla pods with the tray dryer treatment combined with 8 days of further drying tended to be better than all other treatments. This is because tray dryer drying combined with 8 days of advanced sweating on each day of observation resulted in the lowest chroma values of 7.39, 7.05, 6.82, and 6.33, respectively.

In various processes, such as fruit ripening, food processing, or material drying, a decrease in chroma value often occurs due to pigment degradation or chemical changes that reduce the intensity of the original color. For example, in vanilla pods that experience sweating and drying, a decrease in the chroma value indicates that the color of the pod becomes darker and duller as natural pigments such as chlorophyll decrease and chemical reactions increase, producing a dark brown color. This decrease in chroma can also be used as an indicator of product maturity or quality in various industrial contexts (Adawiyah et al., 2020).

3.3.3 Hue Value

The position of the indicator label color change in the hue diagram can be seen in Figure 4. it is shown that the hue value range of fresh and post-treatment of vanilla pods is in quadrant III where a* is negative and b* is positive. The color tends towards green, while the dried vanilla pods in all treatments and controls are in quadrant I which shows a color shift from greenish to reddish brown Figure 4.

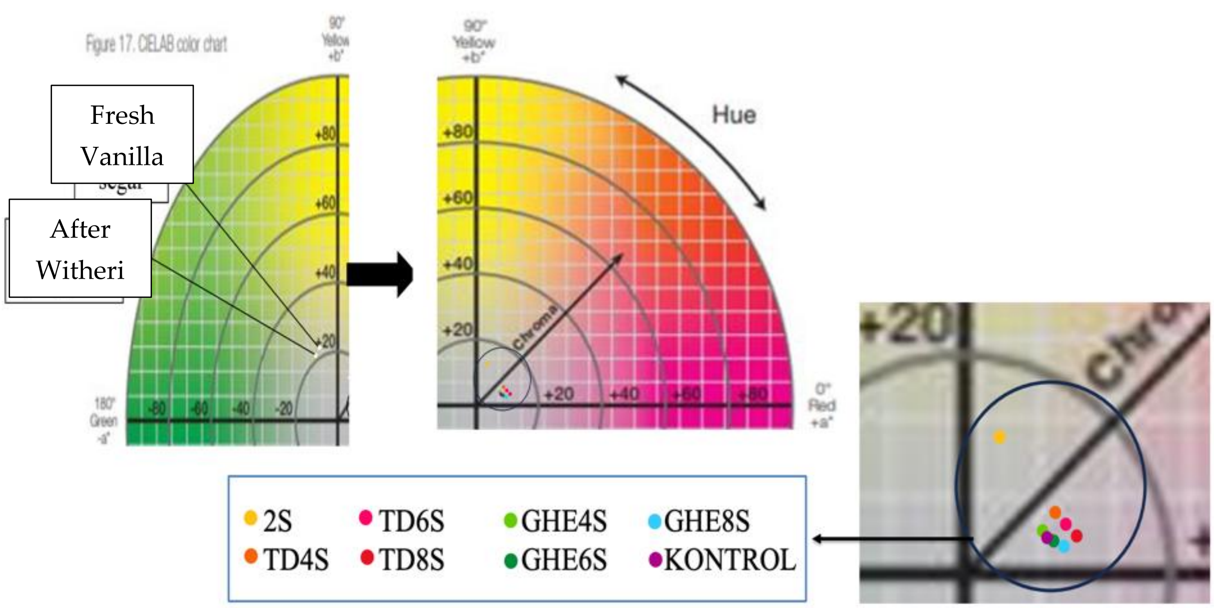

Table 4. Change in Hue of vanilla pods at various treatments.

Table 4. Organoleptic test results of vanilla pods at various treatments.

Treatment	Color	Aroma
TD4S	3.96^{a}	3.64^{ab}
TD6S	4.00^{a}	3.8^{ab}
TD8S	4.56^{a}	4.2^{a}
GHE4S	3.28^{b}	3.6^{ab}
GHE6S	3.00^{b}	3.24^{b}
GHE8S	3.96^{a}	3.68^{ab}
Control	2.2^{c}	1.88^{c}

Notes: Mean numbers followed by different letters in the table indicate significant differences (α = 0.05) in Tukey's further test.

Organoleptic observations on aroma (Table 4) shows that the drying method using the tray dryer with the combination of 4 days, 6 days, and 8 days advanced sweating (TD4S, TD6S, TD8S) produced aroma profiles that were significantly different from the traditional drying method commonly used by farmers (control). Further analysis, comparing the results of drying using the GHE solar dryer with the results of conventional drying by farmers, revealed that a significant difference in aroma characteristics with an average of 4.2 for the TD8S code and 1.88 for the control. As for color, it is shown that the color quality of each treatment sample has a different quality level of panelist preference. Organoleptic test observations on vanilla color (Table 4) showed that panelists liked the vanilla sample with the tray dryer treatment for 8 days. The organoleptic value in 8th day of tray dryer treatment vanilla is higher, with an average value of 4.56 in the organoleptic test, compared to traditional treatment vanilla, which has an average value of 2.2. However, the GHE8S treatment did not provide a significant difference from the 8-day tray dryer (TD8S) treatment.

Increase of vanillin content can enhance aroma intensity that caused by advanced sweating process. However, drying process might contribute to vanillin content or aroma produced. At high moisture levels, volatile compounds tend to be trapped within the fruit tissue, preventing the full development of aroma. Conversely, excessively low moisture content can lead to the loss of some volatile compounds due to evaporation during the drying process. Therefore, an optimal moisture level at which aroma release is maximized without significant loss of volatiles.

This finding is consistent with the study by Dignum et al. (2001), which reported that very low moisture content can result in decreased vanillin concentration the main compound responsible for vanilla aroma. On the other hand, too much moisture can hinder the release of volatile compounds because they remain trapped in the water matrix, thereby suppressing aroma development. Hence, maintaining an optimal moisture level is crucial to producing vanilla with strong and high-quality aroma.

3.4 Drying Rate

Consistent temperature control of 50oC for 7 hours per day accelerated water evaporation in the vanilla pods in the tray dryer (Figure 5). The drying method using the GHE solar dryer during the day can maintain the temperature inside the drying chamber at 53oC, and the average daily temperature of the GHE solar dryer is 43 to 44oC with an average daily solar radiation intensity of about 500 cal/day. To increase the drying efficiency during the day, a blower was turned on at four drying time points for 15 minutes, namely at 09:00, 11:00, 13:00, and 15:00.

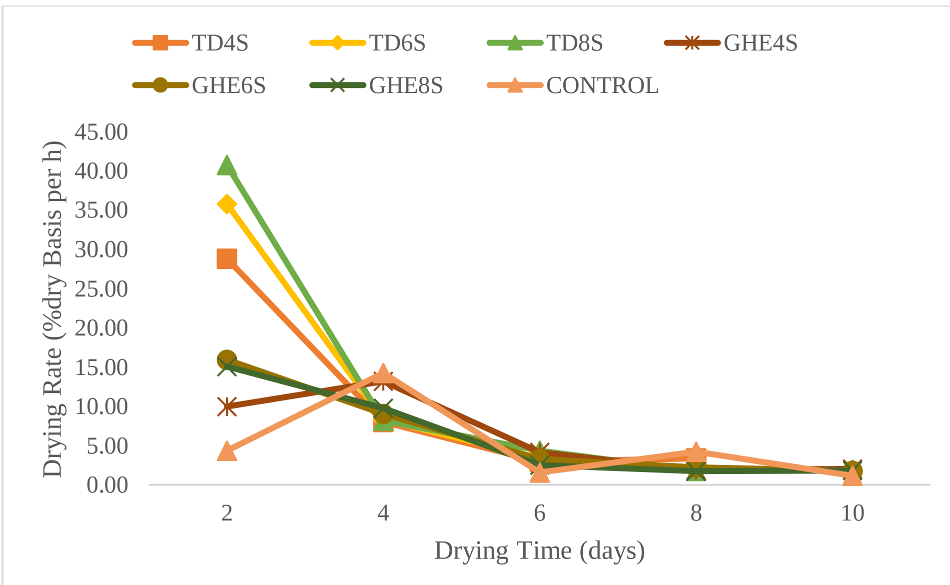

Figure 5. Changes in drying rate of vanilla pods at different treatments.

Drying with the tray dryer and GHE solar dryer methods showed an increased drying rate and a relatively rapid and significant decrease in moisture content (Figure 4). The drying rate of control treatment did not increase much due to only using the existing solar energy source without any retaining heat source.

4. Conclusion

The drying treatment using the tray dryer and GHE solar dryer methods combined with advanced sweating for 4 days (4S), 6 days (6S), and 8 days (8S) had a significant effect on color, aroma, moisture content and vanillin content of vanilla pod.

Drying combined with longer advanced sweating tend to give better quality of vanilla pod than without advanced sweating. The tray dryer treatment combined with 8 days of advanced sweating (TD8S) gave the best vanilla pod quality (1.48% vanillin content) with a shorter drying time (8 days).

Acknowledgement

The author would like to thank the Ministry of Education, Culture, Research and Technology for the research funding support through the scholarship (BPI) program received. The authors also express they're thanks to the Department of Mechanical and Biosystems Engineering and the Center for Research on Engineering Application in Tropical Agriculture (CREATA) IPB University for facilitating the GHE dryer.

5. References

Abdullah, K. and Mursalim. (1997). Drying of vanilla pods using a greenhouse effect solar dryer. Drying Technology, 15(2), 685–698. https://doi.org/doi:10.1080/07373939708917254

Adawiyah, D., Reri, P. and Lioe, H. (2020). The effect of bean size and curing process on aroma profile and vanillin/glucovanillin content of Indonesian cured vanilla beans. Proceedings of the 2nd SEAFAST International Seminar: 106–111. https://doi.org/doi:10.5220/0009977401060111

Amit, S.K., Uddin, M.M., Rahman, R., Islam, S.M., and Khan, M.S. (2017). A review of mechanisms and commercial aspects of food preservation and processing. Agriculture and Food Security. 6(1), 1-22. https://doi.org/10.1186/s40066-017-0130-8.

Association of the Analytical Collaboration (AOAC). (2005). Official Methods of Analysis of The Association Analytical Chemist. Virginia, USA: AOAC International.

Association of the Analytical Collaboration (AOAC). (1981). AOAC 19.011 – 19.012: Vanillin in Vanilla Extract: Rapid Approximate Method Spectrophotometric Method (AOAC 19.011-19.012). USA:AOAC.

BSN. (2002). SNI 01-3395-2002: Specifications for dried vanilla. Jakarta: National Standardization Agency of Indonesia.

CIE (Commision Internationale de I'Eclairage). (1976). CIE 1976 (L, a*, b*) color space. Vienna, Austria: CIE Publication.

Dignum, M. J. W., Kerler, J., and Verpoorte, R. (2001). Vanillin formation in Vanilla planifolia pods: Influence of the curing process. Journal of Agricultural and Food Chemistry, 49(8), 3406–3413. https://doi.org/10.1021/jf010228s

Fitriani, A., Budiastra, I.W., Mardjan, S., and Nurfadilah, N. (2024). Effects of curing method on quality of vanilla pod using a greenhouse effect dryer. Food Research. 8(5): 380-384. https://doi.org/10.26656/fr.2017.8(5).515

Ferdian, Putri L.V., and kiyat, W.E. (2017). Changes in moisture content and microbiology of instant porridge during storage with variations in pre-packing conditions. Journal of Conversion. 8(1):17-32. https://doi.org/10.24853/konversi.8.1.16

Available online:
http://journal.ipb.ac.id/index.php/jtep
DOI: 10.19028/jtep.013.1.147-161

Gu, F., Cai, Y., Hong, Y., Chen, Y., Xu, F. and An, K. (2019). Metabolite transformation and enzyme activities of hainan vanilla beans during curing to improve flavor formation. Molecules, 24, 2781 https://doi.org/doi:10.3390/molecules24152781

Irfan, F., Setyawardani, T., and Sumarmono, J. (2023). Characteristics of color (hue, chroma, whiteness index), yield, and cheese whey percentage with the addition of orthodox black tea (Camellia sinensis var. assamica). UNISRI Journal of Technology and Industry. 8(1): 10-19. https://ejurnal.unisri.ac.id/index.php/jtpr/index

Odoux, E. (2011). Vanilla curing. In Odoux, E. and Grisoni, M. (Eds.). Vanilla: Medicinal and Aromatic Plants Industrial Profiles, p. 189-204. Boca Raton, USA: CRC Press. https://doi.org/10.1201/EBK1420083378

Purseglove, J.W, Brown, E.G, Green C,L, and Robbins, S.R.J. (1981). Journal Spices. 2(3):19-29. Longman. London.

Ranchiano, M.G. and Jamaludin. (2021). Growth of vanilla plants (Vanilla planifolia) in polybags with various combinations of growing media and watering frequencies using drip irrigation. Journal of Agro-Industrial Plantation. 9(2): 65-72. https://doi.org/10.25181/jaip.v9i2.1867

Ranadive, A. S. (1992). Vanilla – cultivation, curing, chemistry, technology and commercial products. Spices and Aromatic Plants, 14(3), 33–39.

Setyaningsih, D, Rusli, M.S, Melawati, and Mariska I. (2006). Optimasi proses maserasi vanili (Vanilla planifolia Andrews) hasil modifikasi proses sweating. Jurnal Teknol dan Industri Pangan. 17(2): 230-239. https://doaj.org/article/caadfe47051e444f912cca5ee0762217

Singh, R.P, and Heldman, D.R. (2014). Introduction to food engineering (5th ed). Academic Press

Sukarto, T.S. (1985). Organoleptic Assessment for Food and Agricultural Products Industries. Jakarta: Bhratara Karya Aksara.

Sumardi, H.S, Rakhmadiono, and Sinawang, T.A. (2001). Mempelajari karakteristik alat pengering buatan untuk processing buah vanili. Jurnal teknologi Pertanian. 2(2): 30-37. https://download.garuda.kemdikbud.go.id/article.php?article=309421&val=7353&title=Study%20of%20the%20Characteristic%20of%20Artificial%20Dryer%20for%20Vanilla%20Processing

Syah, D. (2014). Kimia Pangan: Prinsip dan Analisis. Jakarta: Bumi Aksara.

Van Dyk, S., McGlasson, W.B., Williams, M. and Gair, C. (2010). Influence of curing procedures on sensory quality of vanilla beans. Fruits, 65(6), 387-399. https://doi.org/10.1051/fruits/2010033

Venturi. V., Zennaro, F., Degrassi, G., Okeke, B.C., and Bruschi, C.V. (1998). Genetics of ferulic acid bioconversion to protocatechuic acid in plant-growth-promoting Pseudomonas putida WCS358. Microbiology UK. 144 part 4:965-973. https://doi.org/10.1099/00221287-144-4-965

Warji, W., Tamrin, T., Kuncoro, S., Lanya, B., and Muzaqi, H. (2023). Drying vanilla using a hybrid dryer. Lampung Journal of Agricultural Engineering. 12(1):212-222. https://doi.org/jtep.v12i1.212-222