EFFECT OF SLICE THICKNESS ON THE PHYSICOCHEMICAL AND SENSORY CHARACTERISTICS OF SOLAR-DRIED 'AMBON' BANANA

Miftakhur Rohmah*[1], Yuni Erniwati Kusuma Dewi[1], Anton Rahmadi[1], Magfirotin Marta Banin[1]

[1] Department of Agricultural Product Technology, Faculty of Agriculture, Mulawarman University, Samarinda, Indonesia

Corresponding author: miftakhurrohmah@faperta.unmul.ac.id

Abstract

Dried banana (sale pisang) is a traditional product preserved by reducing the moisture content of ripe bananas. Slice thickness and drying conditions can affect product quality and drying efficiency. This study evaluated the effect of Ambon banana slice thickness on the physicochemical and sensory characteristics of dried banana produced using a solar dryer. A completely randomized design with one factor (slice thickness: 4, 6, or 8 mm) and three replicates was used. Moisture, ash, and sucrose contents; instrumental color (L*, a*, and b*); and sensory attributes (color, aroma, texture, taste, and overall acceptability) were evaluated. Slice thickness significantly affected the physicochemical and sensory characteristics of the product. The 8-mm treatment yielded dried banana with 27.87% moisture, 1.54% ash, 18.85% sucrose, an L* value of 28.14, an a* value of 6.97, and a b* value of 10.38. It also received the highest overall hedonic score (5.13). Under the conditions of this study, the 8-mm slices showed the highest overall acceptability and met the relevant Indonesian National Standard limits for moisture and ash.

Keywords:

Ambon banana; slice thickness; solar dryer; physicochemical properties; sensory quality

1. Introduction

Banana is an important horticultural commodity because it is widely consumed, nutritionally valuable, and produced in substantial quantities. Recent official statistics continue to document banana production as an important component of horticulture in East Kalimantan (Badan Pusat Statistik Provinsi Kalimantan Timur, 2025). Ambon banana (*Musa acuminata*, Cavendish subgroup) is one of the varieties commonly consumed in the region.

Like other ripe bananas, Ambon banana is highly perishable because of its high moisture content and rapid physiological deterioration after harvest. Converting the fruit into dried banana can extend its usability, create added value, and provide a practical product for local producers. Recent studies show that drying conditions and pretreatments strongly influence the quality and sensory response of dried banana slices (Abd El-Wahhab et al., 2023; Nadery Dehsheikh et al., 2025).

Drying reduces the amount of available water and thereby improves product stability, but the final quality of dried banana depends on the balance between moisture removal and retention of desirable sensory attributes. Slice thickness is a key processing variable because it affects the distance travelled by water from the tissue interior to the surface, heat and mass transfer, drying rate, and the extent of structural change. These effects can subsequently influence moisture content, sugar concentration, surface color, and texture (Amer et al., 2023; Kamble et al., 2022; Kushwah et al., 2023).

Traditional open sun drying is strongly influenced by weather and may expose the product to dust and other environmental contaminants. A solar dryer provides a more protected drying environment while still using solar energy; however, variation in slice geometry can still lead to differences in the quality of the final product. Recent solar- and heat-pump-drying studies confirm that dryer conditions and sample thickness influence moisture removal and color retention in banana slices (Mawire et al., 2024; Sujinda et al., 2024; Sun et al., 2024).

Recent research has examined banana drying under convective, infrared, microwave, vacuum, and hybrid conditions. These studies consistently show that process conditions influence physicochemical quality, color, texture, and sensory characteristics (Abrahão et al., 2024; Atmaca & Büyükcan, 2025; Dadhaneeya et al., 2023; Han et al., 2025; Dhake et al., 2025). Research using heat-pump electrohydrodynamic, swell-, and indoor-convection drying likewise shows that drying conditions and slice geometry strongly influence banana quality (Meng et al., 2022; Trivedi et al., 2023; Sangwan et al., 2025). However, information on solar-dried Ambon banana that combines physicochemical measurements with both hedonic and descriptive sensory responses remains limited.

Therefore, this study evaluated the effect of 4, 6, and 8 mm slice thicknesses on the moisture, ash, sucrose, instrumental color, and sensory characteristics of solar-dried Ambon banana. The study aimed to identify the slice thickness that provides the most favourable quality profile under the experimental conditions.

2. Materials and Methods

Materials

The materials used were Ambon bananas obtained from Bhuana Jaya Village, Kutai Kartanegara; 0.1% Koepoe® sodium benzoate (PT Gunacipta Multirasa); distilled water; boiling chips (Merck, Germany); Luff–Schoorl solution (Merck, Germany); 20% potassium iodide (Merck, Germany); 25% sulfuric acid (Merck, Germany); 0.1 N sodium thiosulfate (Merck, Germany); 0.5% starch (Merck, Germany); 25% hydrochloric acid (Merck, Germany); phenolphthalein indicator (Merck, China); and 30% sodium hydroxide (Merck, Germany).

Equipment

The equipment consisted of a solar dryer dome, a CS-10 colorimeter (PCE-CSM1, USA), a UN55 oven (Germany), a Carbolite furnace (Germany), a DN 300 desiccator (Germany), a digital screw micrometer, a hot plate, analytical balances, porcelain crucibles, volumetric pipettes, and laboratory glassware.

Experimental Design

A one-factor completely randomized design was used. The factor was banana slice thickness at three levels: 4, 6, and 8 mm. Each treatment was replicated three times. The measured variables were moisture content, ash content, sucrose content, instrumental color, and sensory characteristics assessed through hedonic and descriptive sensory tests.

The data were analyzed using analysis of variance (ANOVA) at a significance level of $\alpha = 0.05$. When a significant difference was detected, the least significant difference test was applied. Hedonic and descriptive sensory data were analyzed using the Kruskal–Wallis test.

Production of Dried Banana

Ambon bananas were sorted according to ripeness and peeled. The fruit was then sliced to thicknesses of 4, 6, or 8 mm, and equal amounts of each treatment were weighed. The slices were immersed in 0.1% sodium benzoate solution for 15 min, placed on trays, and dried in a solar dryer dome.

Chemical Analyses

Moisture and ash contents were determined using standard gravimetric procedures, while sucrose was determined using the Luff-Schoorl method. The procedures were implemented with reference to current official analytical-method guidance (AOAC INTERNATIONAL, 2023).

Color Measurement

Color was measured using a colorimeter (PCE-CSM1, USA) and expressed as L* (lightness), a* (green-red coordinate), and b* (blue-yellow coordinate) values. These coordinates are commonly used to assess drying-related color changes in banana slices (Atmaca & Büyükcan, 2025; Sujinda et al., 2024).

Sensory Evaluation

Sensory evaluation involved 30 semi-trained panelists aged 19-22 years who had completed a sensory evaluation course. Hedonic and descriptive sensory tests used seven-point scales to assess color, texture, aroma, taste, and overall acceptability. For the hedonic test, the scale was 1 (dislike extremely), 2 (dislike very much), 3 (dislike), 4 (neither like nor dislike), 5 (like), 6 (like very much), and 7 (like extremely).

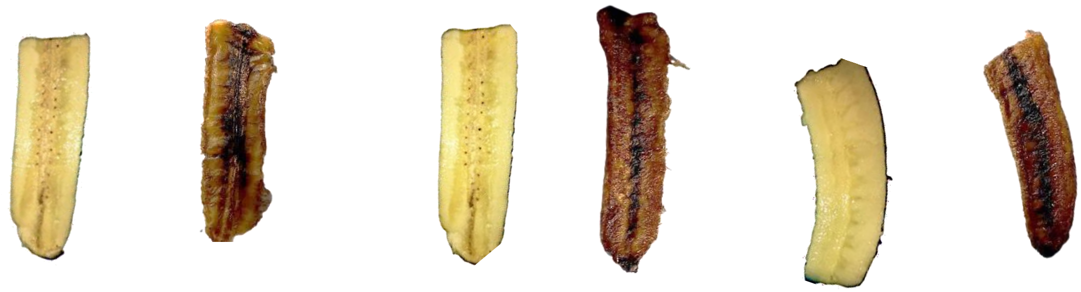
3. Results

Ambon bananas were processed into dried banana using three slice-thickness treatments. Chemical, physical, and sensory characteristics were subsequently evaluated. The chemical analysis results are presented in Table 1.

Table 1. Effect of Ambon banana slice thickness on moisture, ash, and sucrose contents

Parameter	Slice-thickness treatment		
	P1 (4 mm)	**P2 (6 mm)**	**P3 (8 mm)**
Moisture content (%)	19.95 ± 0.48^{a}	21.75 ± 0.37^{b}	27.87 ± 0.90^{c}
Ash content (%)	2.46 ± 0.11^{c}	2.24 ± 0.04^{b}	1.54 ± 0.13^{a}
Sucrose content (%)	21.02 ± 0.08^{c}	19.91 ± 0.28^{b}	18.85 ± 0.15^{a}

Color Characteristics



(a) (b) (c) (d) (e) (f)

Figure 1. Visual appearance of Ambon banana slices before and after solar drying at three slice thicknesses: (a) 4 mm before drying; (b) 4 mm after drying; (c) 6 mm before drying; (d) 6 mm after drying; (e) 8 mm before drying; and (f) 8 mm after drying.

The descriptive sensory result of a darker brown appearance for the 8-mm treatment does not necessarily contradict the higher L* value. Instrumental color represents a small, standardized measurement area, whereas panelists judge the whole sample, including surface gloss, browning heterogeneity, and visual thickness. The darker visual impression may be associated with localized Maillard browning, while the higher L* value may reflect a lighter average surface. Standardizing the measurement location and adding browning-index or image-analysis data would help reconcile instrumental and sensory color findings. The complete color results are presented in Table 2.

Table 2. Instrumental color characteristics of dried Ambon banana

Color parameter	Treatment		
	P1 (4 mm)	P2 (6 mm)	P3 (8 mm)
L*	21.37 ± 0.71^{a}	25.66 ± 0.82^{b}	28.14 ± 0.88^{c}
a*	1.08 ± 0.69^{a}	3.47 ± 0.83^{b}	6.97 ± 0.61^{c}
b*	4.97 ± 0.45^{a}	7.46 ± 0.76^{b}	10.38 ± 0.57^{c}

Note: Values are means ± standard deviations. Different superscript letters within a row indicate significant differences at $\alpha = 0.05$.

Sensory Characteristics

Table 3. Hedonic scores of dried Ambon banana produced using different slice thicknesses

Treatment	Attribute				
	Color	Aroma	Texture	Taste	Overall acceptability
P1 (4 mm)	3.77 ± 0.17^{a}	3.74 ± 0.50^{a}	4.18 ± 0.29^{a}	3.57 ± 0.06^{a}	3.47 ± 0.05^{a}
P2 (6 mm)	4.79 ± 0.26^{b}	3.97 ± 0.24^{a}	4.30 ± 0.51^{a}	4.74 ± 0.15^{b}	4.43 ± 0.28^{b}
P3 (8 mm)	5.37 ± 0.51^{c}	4.97 ± 0.38^{b}	5.13 ± 0.17^{b}	5.74 ± 0.50^{c}	5.13 ± 0.16^{c}

Note: Values are means ± standard deviations. Different superscript letters within a column indicate significant differences at $\alpha = 0.05$.

Table 4. Descriptive sensory scores of dried Ambon banana produced using different slice thicknesses

Treatment	Attribute			
	Color	Aroma	Texture	Taste
P1 (4 mm)	3.77 ± 0.17[a]	3.57 ± 0.06[a]	4.74 ± 0.50[a]	4.13 ± 0.17[a]
P2 (6 mm)	3.88 ± 0.11[a]	4.36 ± 0.22[b]	4.40 ± 0.30[b]	5.02 ± 0.36[b]
P3 (8 mm)	4.80 ± 0.51[b]	5.46 ± 0.27[c]	4.56 ± 0.52[c]	5.73 ± 0.22[c]

Note: Values are means ± standard deviations. Different superscript letters within a column indicate significant differences at $\alpha = 0.05$.

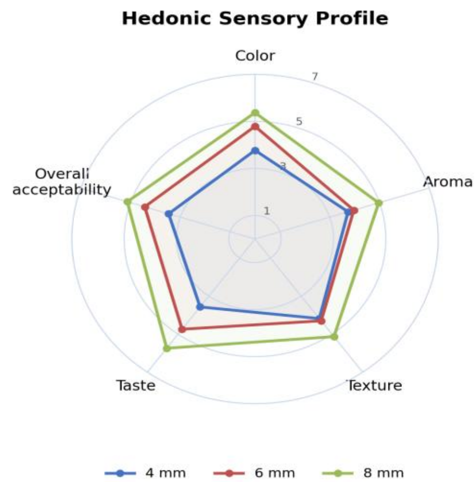


Figure 2. Hedonic sensory scores of solar-dried Ambon banana at slice thicknesses of 4, 6, and 8 mm. Higher scores indicate greater panelist preference for color, aroma, texture, taste, and overall acceptability.

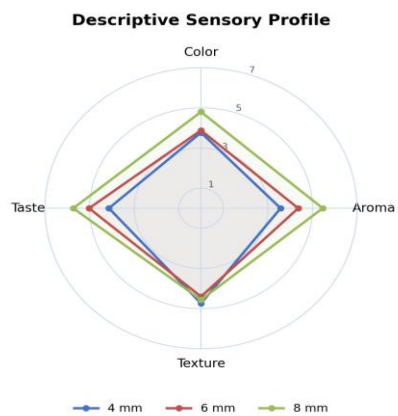


Figure 3. Descriptive sensory profile of solar-dried Ambon banana at slice thicknesses of 4, 6, and 8 mm. Higher scores indicate a stronger perceived intensity of the assessed attribute, not necessarily greater preference.

Figures 2 and 3 summarize the same treatments but answer different sensory questions. Figure 2 presents hedonic responses, so a higher score means the panelists liked the attribute more. Figure 3 presents descriptive responses, so a higher score means the attribute was perceived more strongly; it should not be interpreted automatically as a higher level of liking.

4. Discussion

Moisture Content

As shown in Table 1, the moisture content of dried Ambon banana increased significantly with slice thickness, from 19.95% at 4 mm to 27.87% at 8 mm. All treatments complied with the Indonesian National Standard (SNI) maximum moisture limit of 40%. However, compliance with this limit should not be interpreted as equivalent to identical storage stability because products with different moisture contents may differ in softness, water activity, and susceptibility to quality changes during storage.

The trend is consistent with internal moisture migration as the rate-limiting stage of drying. A thicker slice has a lower surface-area-to-volume ratio and a longer distance for water to move from the centre to the surface. Consequently, less water can be removed during a given drying period. This mechanism agrees with controlled drying studies showing that banana-slice moisture removal is strongly affected by product geometry and drying conditions, including air temperature and air velocity (Amer et al., 2023). In the present study, the higher moisture content of the 8-mm treatment may have contributed to its softer texture and greater consumer acceptance. Nevertheless, moisture content alone is insufficient to establish shelf-life safety; future work should measure water activity and microbiological quality during storage.

Ash Content

Ash content decreased significantly as slice thickness increased, from 2.46% in the 4-mm treatment to 1.54% in the 8-mm treatment. Only the 8-mm treatment was below the SNI maximum ash-content limit of 2.0%. Because mineral matter is not expected to volatilize under ordinary food-drying conditions, this difference should be interpreted carefully as an apparent change in ash concentration rather than direct mineral loss.

The higher retained moisture in thicker slices may dilute mineral constituents when ash is expressed on a wet-weight basis. Differences in sample composition, tissue distribution, and the degree of concentration during drying may also contribute to the observed values. Therefore, the result indicates a thickness-related difference in measured ash content, but it does not by itself demonstrate a change in the absolute mineral content of the banana. Reporting results on both wet and dry bases in future work would clarify the role of moisture concentration.

Sucrose Content

Sucrose content decreased significantly from 21.02% in the 4-mm treatment to 18.85% in the 8-mm treatment. This pattern coincided with the increase in moisture content. When sugars are expressed as a percentage of product mass, a higher proportion of retained water can reduce the measured concentration through dilution. Thermal exposure may also alter sugar composition through hydrolysis and non-enzymatic browning reactions, although reducing sugars were not measured in this study.

The lower sucrose value in the 8-mm treatment should therefore not be interpreted as evidence of a less sweet product. In fact, the 8-mm treatment received the highest hedonic taste score. Sweetness perception reflects the integrated contribution of sugars, aroma, acidity, texture, and moisture release during mastication, rather than sucrose concentration alone. A future study that measures total sugars, reducing sugars, and soluble solids together would provide a stronger explanation of the sensory response.

Color Characteristics

The 8-mm treatment had higher instrumental color values than the 6- and 4-mm treatments. Drying duration and the intensity of sunlight entering the solar dryer can affect the final color. Drying studies on banana slices show that temperature, radiation intensity, and moisture removal can modify L*, a*, and b* values through pigment changes and non-enzymatic browning (Amer et al., 2023; Atmaca & Büyükcan, 2025; Han et al., 2025).

Organoleptic Characteristics

Color

Slice thickness significantly affected the color of dried Ambon banana. Hedonic color scores ranged from 3.77 to 5.37 (neither like nor dislike to like), whereas descriptive color scores ranged from 3.77 to 4.80 (brown to dark brown). The radar chart (Figure 3) shows that the 8-mm treatment, characterized by a dark-brown color, received the highest color score.

The color changes observed in all treatments are consistent with drying-related browning reactions and variation in moisture removal. Recent banana-drying studies likewise report that process conditions and pretreatments can influence browning, color coordinates, and sensory color acceptance (Abd El-Wahhab et al., 2023; Abrahão et al., 2024; Dadhaneeya et al., 2023).

Aroma

Slice thickness significantly affected both hedonic and descriptive aroma scores, with the 8-mm treatment receiving the highest values. A thicker slice may retain more moisture and volatile compounds within its matrix during drying, thereby producing a more recognizable banana aroma when consumed. However, the present study did not measure volatile compounds; the finding should therefore be interpreted as a panelist perception rather than evidence of a specific aroma mechanism (Kumar et al., 2025; Nadery Dehsheikh et al., 2025).

This interpretation should remain cautious because volatile compounds and drying time were not measured. The present data support the conclusion that panelists perceived the 8-mm sample as having a stronger banana aroma, but they do not identify the specific compounds responsible. Gas chromatography analysis or a trained descriptive panel would be useful to verify whether the difference reflects volatile retention, thermal aroma formation, or both.

Texture

Slice thickness significantly affected texture. Hedonic texture scores ranged from 4.18 to 5.13, and the 8-mm treatment was most preferred. In contrast, descriptive texture scores ranged only from 4.40 to 4.74, with the 4-mm treatment receiving the highest descriptive score. This difference shows why hedonic and descriptive tests should be interpreted separately: a panelist may recognize one texture characteristic most strongly without necessarily preferring it.

The higher hedonic score of the 8-mm slices is plausibly related to their higher moisture content, which may have produced a softer and less rigid bite. Thinner slices lose water more rapidly and can develop a denser or tougher structure as cellular material contracts. Similar links between drying conditions, moisture removal, texture, and sensory quality have been reported for banana slices (Amer et al., 2023; Han et al., 2025; Kushwah et al., 2022).

Taste

Slice thickness significantly affected taste, and the 8-mm treatment had the highest hedonic and descriptive taste scores. The greater moisture retained by thicker slices may have improved the release of soluble taste compounds during mastication and reduced the perception of excessive dryness. Similar interactions among drying conditions, physicochemical properties, and sensory quality have been reported in dried banana studies (Abd El-Wahhab et al., 2023; Dadhaneeya et al., 2023; Kumar et al., 2025).

Although Maillard reactions may contribute to desirable cooked notes and browning, the study did not measure reducing sugars, organic acids, or volatile compounds. Therefore, the sensory finding should be presented as an observed preference rather than proof of a specific chemical pathway. Combining sensory data with soluble solids, reducing-sugar, and aroma analysis would strengthen the explanation of taste development.

Overall Acceptability

Slice thickness significantly affected overall acceptability. The 8-mm treatment received the highest score (5.13), whereas the 4-mm treatment received the lowest score (3.47). Its higher acceptance was supported by favorable hedonic scores for color, aroma, texture, and taste, indicating that panelists assessed the product as a coherent sensory experience rather than on the basis of a single attribute.

From a processing perspective, 8 mm is the most promising thickness among those evaluated when the objective is immediate consumer acceptance. This recommendation should be limited to the present solar-drying conditions and the panel group used in the study. The higher moisture content of the 8-mm product may be beneficial for palatability but could require closer control of packaging and storage. Product-quality decisions should therefore balance sensory acceptance with water activity, microbiological stability, drying time, energy use, and yield.

5. Conclusion

Slice thickness significantly affected the moisture, ash, and sucrose contents; instrumental color; and sensory characteristics of dried Ambon banana. Under the conditions of this study, the 8-mm slices showed the highest overall acceptability, with 27.87% moisture, 1.54% ash, 18.85% sucrose, an L* value of 28.14, an a* value of 6.97, a b* value of 10.38, and an overall hedonic score of 5.13. This treatment met the relevant Indonesian National Standard limits for moisture and ash. The solar dryer provided a protected drying environment for the product

Acknowledgements

The authors gratefully acknowledge PT Indobara Pratama for providing financial support for the publication of this article. The authors also thank the Postharvest Laboratory, Department of Agricultural Product Technology, Faculty of Agriculture, Mulawarman University; the East Kalimantan Food Crops and Horticulture Service; and the Bhuana Jaya Village Farmers Group, Kutai

Kartanegara, for their support in conducting this research through the Independent Campus Competition Program collaborative research scheme.

Conflict of Interest

The authors declare no conflict of interest.

Funding

This study was supported through the Independent Campus Competition Program collaborative research scheme.

References

Abd El-Wahhab, G. G., Sayed, H. A. A., Abdelhamid, M. A., Zaghlool, A., Nasr, A., Nagib, A., Bourouah, M., Abd-ElGawad, A. M., Rashad, Y. M., Hafez, M., & Taha, I. M. (2023). Effect of pre-treatments on the qualities of banana dried by two different drying methods. *Sustainability, 15*(20), 15112. https://doi.org/10.3390/su152015112

Abrahão, F. R., Corrêa, J. L. G., Sousa, A. B. M., & Silveira, P. G. (2024). Effect of ultrasound and osmotic dehydration as pretreatments on the infrared drying of banana slices. *Food Technology and Biotechnology*, *62*(3), 384–396. https://doi.org/10.17113/ftb.62.03.24.8409

AOAC INTERNATIONAL. (2023). *Official methods of analysis of AOAC INTERNATIONAL* (22nd ed.). Oxford University Press.

Amer, B. M. A., Azam, M. M., & Saad, A. (2023). Monitoring temperature profile and drying kinetics of thin-layer banana slices under controlled forced convection conditions. *Processes*, *11*(6), 1771. https://doi.org/10.3390/pr11061771

Atmaca, M., & Büyükcan, M. B. (2025). Infrared drying of banana slices: Quality evaluation using spectral and microstructural analysis. *Applied Sciences*, *15*(17), 9632. https://doi.org/10.3390/app15179632

Badan Pusat Statistik Provinsi Kalimantan Timur. (2025). *Statistik sayur-sayuran dan buah-buahan Provinsi Kalimantan Timur 2024*. https://kaltim.bps.go.id/id/publication/2025/08/01/b4f68e90be8d1c4e5017361c/statistik-sayur-sayuran-dan-buah-buahan-provinsi-kalimantan-timur-2024.html

Dadhaneeya, H., Nayak, P. K., Saikia, D., Kondareddy, R., Ray, S., & Kesavan, R. (2023). The impact of refractance window drying on the physicochemical properties and bioactive compounds of Malbhog banana slice and pulp. *Applied Food Research*, *3*, 100279. https://doi.org/10.1016/j.afres.2023.100279

Dhake, K. P., Jain, S. K., Jagtap, S., & Pathare, P. B. (2025). Optimization of drying parameters for pretreated green banana slices using response surface methodology. *Journal of Food Quality*, *2025*, 3959937. https://doi.org/10.1155/jfq/3959937

Han, G., Luo, C., Liu, X., Li, Y., Cheng, Y., Huang, S., & Huang, D. (2025). Drying characteristics and process optimization of banana slices using hot air-infrared combined drying. *Frontiers in Heat and Mass Transfer*, *23*(6), 1981–1999. https://doi.org/10.32604/fhmt.2025.074593

Kamble, M., Singh, A., Singh, S. V., Chinchkar, A., & Pareek, S. (2022). Optimization of convective tray-drying process parameters for green banana slices using response surface methodology and its characterization. *Journal of Food Quality*, *2022*, 8208572. https://doi.org/10.1155/2022/8208572

Kumar, P. S., Shelake, P., & Pushpavalli, S. (2025). Comprehensive analysis of energy efficiency, volatile aroma profile, physicochemical and sensorial attributes in relation to different drying

conditions for ripe banana fruits. *Journal of Food Process Engineering*, *48*(8), e70200. https://doi.org/10.1111/jfpe.70200
Kushwah, A., Kumar, A., & Gaur, M. K. (2022). Drying kinetics, performance, and quality assessment for banana slices using heat pump-assisted drying system (HPADS). *Journal of Food Process Engineering*, *45*(3), e13964. https://doi.org/10.1111/jfpe.13964
Kushwah, A., Kumar, A., & Gaur, M. K. (2023). Optimization of drying parameters for hybrid indirect solar dryer for banana slices using response surface methodology. *Process Safety and Environmental Protection, 170*, 1–12. https://doi.org/10.1016/j.psep.2022.12.003
Mawire, A., Ramokali, M., Mothupi, M., & Vanierschot, M. (2024). An experimental evaluation of drying banana slices using a novel indirect solar dryer under variable conditions. *Heliyon*, *10*(7), e28268. https://doi.org/10.1016/j.heliyon.2024.e28268
Meng, Z., Cui, X., Liu, Y., Chen, M., & Yu, Z. (2022). Drying characteristics of banana slices under heat pump-electrohydrodynamic combined drying. *Sustainable Energy Technologies and Assessments, 54*, 102907. https://doi.org/10.1016/j.seta.2022.102907
Nadery Dehsheikh, F., Taghian Dinani, S., Koczoń, P., Bryś, J., Niemiec, T., & Kouřimská, L. (2025). Quality properties of dried banana slices with carboxymethyl cellulose coating ultrasonic pretreatments. *Foods*, *14*(22), 3904. https://doi.org/10.3390/foods14223904
Sangwan, M., Sahdev, R. K., Tiwari, S., Chhabra, D., Suhag, S., Kumari, M., & Sahdev, A. (2025). Sustainable indoor convection drying of banana slices: Kinetics and model validation. *Journal of Food Process Engineering, 48*(12), e70285. https://doi.org/10.1111/jfpe.70285
Sujinda, N., Saengsuwan, T., & Chaichana, N. (2024). A study on drying characteristics, color, and vitamin C preservation of green banana slices using a vacuum heat pump system. *Agricultural Engineering, 28*, 167–184. https://doi.org/10.2478/agriceng-2024-0011
Sun, Z., Wang, Q., Yuan, Y., Wang, D., Zhou, Q., Xu, C., Meng, K., Peng, H., Yan, L., Jin, R., Li, L., Liu, H., Wang, Y., & Hu, J. (2024). Experimental analysis of a CO2 closed heat pump drying system combined with rotary dehumidification for drying banana slices. *International Journal of Refrigeration, 160*, 76–87. https://doi.org/10.1016/j.ijrefrig.2024.01.017
Trivedi, D., Gautam, S. P., Abdul, S., Hazarika, M. K., & Chakraborty, S. (2023). Instant decompression-induced swell drying of banana: Machine learning and swarm intelligence embedded modeling and process optimization. *Journal of Food Process Engineering, 46*(11), e14431. https://doi.org/10.1111/jfpe.14431