International Journal of Multidisciplinary Trends

E-ISSN: 2709-9369
P-ISSN: 2709-9350
Impact Factor (RJIF): 6.32
www.multisubjectjournal.com
IJMT 2025; 7(11): 50-52
Received: 04-09-2025
Accepted: 08-10-2025

Vijay Kumar Singh
Department of Processing and Food Engineering, Mahamaya College of Agricultural Engineering and Technology, Ambedkar Nagar, Uttar Pradesh, India

Shashank Verma
Department of Processing and Food Engineering, Mahamaya College of Agricultural Engineering and Technology, Ambedkar Nagar, Uttar Pradesh, India

Vipul Chaudhary
Department of Processing and Food Engineering, Mahamaya College of Agricultural Engineering and Technology, Ambedkar Nagar, Uttar Pradesh, India

Corresponding Author:
Vijay Kumar Singh
Department of Processing and Food Engineering, Mahamaya College of Agricultural Engineering and Technology, Ambedkar Nagar, Uttar Pradesh, India

Research note

Effect of drying temperature on the nutritional and physical properties of banana chips

Vijay Kumar Singh, Shashank Verma and Vipul Chaudhary

Abstract
This research investigates the effect of different hot-air drying temperatures (50 °C, 60 °C, 70 °C, and 80 °C) on the nutritional, textural, and color characteristics of banana chips derived from Musa paradisiaca. Comparative analysis with vacuum drying was conducted using data from recent studies to assess the technological and nutritional advantages of each method. The results showed that increasing temperature significantly reduced drying time and moisture content but decreased vitamin C and total phenolic content. Optimum results for texture and color were obtained between 60-70 °C. Vacuum drying retained higher nutritional value but resulted in slightly firmer texture. Hot air drying at 65 °C is identified as the most efficient and economical temperature for banana chip production.

Keywords: Banana chips, hot-air drying, vacuum drying, nutritional quality, moisture content, texture

Introduction
Bananas (*Musa* spp.) are one of the most consumed tropical fruits worldwide, valued for their taste, nutrition, and economic importance. Banana chips are a major processed product, offering extended shelf life and convenience (Aurore *et al*., 2009) [2]. Drying temperature significantly affects product quality, as higher heat can degrade thermolabile compounds such as vitamin C and phenolic content (Silva *et al*., 2018) [3]. Hot-air drying is the most common commercial method due to its simplicity and cost-effectiveness (Kumar & Gupta, 2020) [5], whereas vacuum drying minimizes oxidative degradation and color loss (Suhaja *et al*., 2023) [7]. This study evaluates the influence of hot-air drying temperature on nutritional, color, and texture parameters of banana chips and compares results to vacuum drying reported in recent literature.

Materials and Methods
Raw Material Preparation
Fully mature, defect-free bananas (*Musa paradisiaca*, variety "Nendran") were procured from a local market in Ambedkar Nagar. Fruits were washed, peeled, and sliced into uniform thickness (3 mm). The slices were blanched at 90 °C for 2 minutes to inactivate enzymes, then drained and blotted dry.

Drying Procedure
Samples were dried using a laboratory-scale hot air oven (Make: Remi Instruments Pvt. Ltd.) at four different temperatures: 50 °C, 60 °C, 70 °C, and 80 °C until the moisture content reached below 5% (wet basis). Air velocity was maintained at 2.0 m/s. Drying time was recorded at 30-minute intervals.

Physicochemical Analysis
a) **Moisture Content:** Determined by oven-drying at 105 °C to constant weight (AOAC, 2016) [1].
b) **Vitamin C Content:** Estimated using the 2, 6-dichlorophenolindophenol titration method.
c) **Total Phenolic Content (TPC):** Measured spectrophotometrically using the Folin-Ciocalteu reagent and expressed as mg GAE/100 g dry weight.
d) **Color Measurement:** L*, a*, b* values determined using a Minolta CR-400 colorimeter.
e) **Texture Analysis:** Crispness measured using a Texture Analyzer (Stable Micro Systems, UK).
f) **Statistical Analysis:** Data were analyzed using ANOVA ($p < 0.05$) in SPSS v25.

Results and Discussion

The effect of drying temperature on the drying characteristics, nutrient composition, and physical attributes of banana chips is presented below. Comparative observations with vacuum drying are discussed to highlight performance differences in product quality.

Table 1: Effect of drying temperature on drying time and final moisture content

Temperature (°C)	Drying Time (min)	Final Moisture (%)
50	360 ± 5	5.2 ± 0.1
60	270 ± 4	4.8 ± 0.1
70	210 ± 3	4.5 ± 0.1
80	150 ± 3	4.3 ± 0.1

Drying time decreased significantly ($p < 0.05$) as temperature increased from 50 °C to 80 °C. The moisture reduction pattern aligned with previous findings by Kumar and Gupta (2020) [5]. However, excessive temperature (80 °C) caused surface case hardening and uneven internal drying, consistent with observations by Chigbo *et al*. (2024) [8] in vacuum drying studies.

Table 2: Effect of temperature on nutritional composition of banana chips

Temperature (°C)	Vitamin C (mg/100g)	TPC (mg GAE/100g)	Protein (%)
50	7.8 ± 0.3	85 ± 2.1	2.21 ± 0.05
60	7.0 ± 0.2	80 ± 1.9	2.20 ± 0.04
70	6.2 ± 0.2	74 ± 2.4	2.19 ± 0.06
80	5.0 ± 0.3	63 ± 1.7	2.17 ± 0.05

Vitamin C and total phenolic content declined with increasing temperature due to thermal degradation and oxidation, confirming prior reports by Silva *et al*. (2018) [3]. Hot-air drying at 60-70 °C retained acceptable nutrient levels comparable to vacuum-dried chips, which maintain approximately 15-20% higher antioxidant capacity (Suhaja *et al*., 2023) [7]. Protein content remained relatively stable across treatments.

Table 3: Effect of drying temperature on color and texture parameters

Temperature (°C)	L* (Lightness)	a* (Redness)	b* (Yellowness)	Crispness (N)
50	71.5	8.3	25.6	4.2
60	69.1	9.1	27.8	5.8
70	66.4	10.6	29.3	6.1
80	61.8	12.9	30.1	5.9

Color parameters showed decreasing lightness (L*) and increasing redness (a*) with temperature, indicating intensified Maillard reactions (Doymaz, 2010) [4]. Vacuum drying studies (Heliyon, 2023) [9] showed 10-12% higher L* values due to reduced oxidation. Texture measurements revealed maximum crispness between 60 °C and 70 °C, while higher temperatures increased brittleness and decreased sensory acceptability.

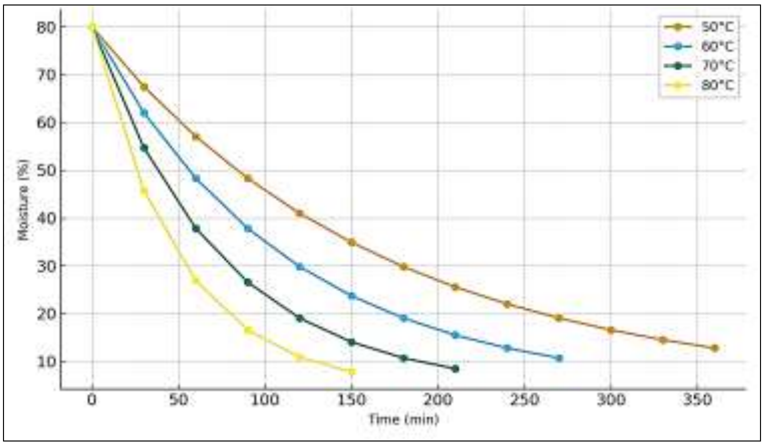

Fig 1: Drying curve shows moisture reduction at different temperatures

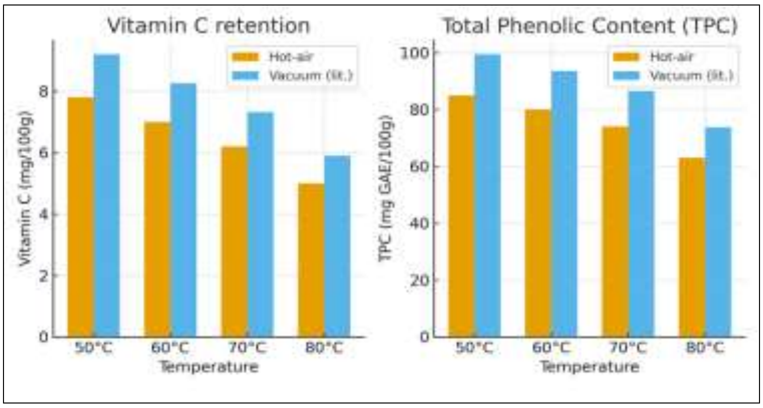

Fig 2: Comparative nutrient retention between hot-air and vacuum drying

Overall, the 60-70 °C range is optimal for achieving desirable balance among drying rate, color, texture, and nutrient preservation. Although vacuum drying offers better nutrient retention, its high operational cost limits industrial scalability (Sangdoung *et al*., 2024) [10].

Conclusion

Hot air drying significantly affects the quality of banana chips. Increasing temperature enhances drying efficiency but leads to nutrient loss and darker color. The best quality in terms of texture and acceptable nutrient retention was achieved between 60-70 °C. Comparison with vacuum drying suggests that while nutrient retention is superior in vacuum systems, hot-air drying remains a practical, cost-effective option for commercial banana chip production.

References

1. AOAC. Official Methods of Analysis. 20th ed. Washington, D.C.: Association of Official Analytical Chemists; 2016.
2. Aurore G, Parfait B, Fahrasmane L. Bananas, raw materials for making processed food products. Trends in Food Science & Technology. 2009;20(2):78-91.
3. Lewicki PP. Design of hot-air drying for better foods. Trends in Food Science & Technology. 2006;17(4):153-163.
4. Doymaz İ. Effect of air temperature and slice thickness on drying characteristics of sweet potato. Food and Bioproducts Processing. 2010;88(2-3):143-151.
5. Kumar P, Gupta N. Modeling of drying kinetics and quality changes in fruits. Journal of Food Process Engineering. 2020;43(3):e13149.
6. Silva KF, Nunes ML, Almeida DP. Vitamin C losses during thermal processing of fruit-based products. LWT - Food Science and Technology. 2018;90:412-418.
7. Suhaja BMA, Azam MM, AbdelGawad S. Monitoring temperature profile and drying kinetics of thin-layer banana slices. Processes. 2023;11(6):1771.
8. Chigbo KS, Linus-Chibuezeh A, *et al*. Mathematical modelling of temperature effects on banana drying. Food Production, Processing and Nutrition. 2024;6:51.
9. Heliyon. Quality attributes of banana flour: Effects of drying methods. Heliyon. 2023;9(7):e18312.
10. Sangdoung C, Intaravicha N, Maksuwan A. Suitable drying characteristics for dried banana chips. Journal of Vocational Education in Agriculture. 2024;8(1):87-101.
11. Salunke S, Yadav KC, Kadam S. Effect of microwave drying on banana chips. Journal of Pharmacognosy and Phytochemistry. 2019;8(2):7978.
12. Islam MS, Haque MA, Islam MN. Effects of drying parameters on banana dehydration. The Agriculturists. 2012;10(1):87-97.
13. Ranasalva N, Sudheer KP. Effect of pre-treatments on quality of vacuum-fried banana chips. Journal of Tropical Agriculture. 2017;55(2):161-166.
14. Sagar VR, Kumar PS. Recent advances in drying of fruits and vegetables: A review. Journal of Food Science and Technology. 2010;47(1):15-26.
15. Petikirige P. Effect of drying techniques on tropical fruits quality. International Journal of Food Science & Technology. 2022;1-10.
16. Frontiers in Sustainable Food Systems. Convection drying and phytochemical changes in green banana flour. Frontiers in Sustainable Food Systems. 2023;7:1204349.
17. IOP Conference Series: Materials Science and Engineering. Effect of drying airflow on banana chips drying. MSE. 2021;1187(1):012043.
18. SpringerLink. Effects of pressure and temperature on banana chip quality. Journal of Food Measurement and Characterization. 2021;15:5637-5647.
19. Dandago MA, Ibrahim S. Effect of drying methods on banana pulp chemistry. Nigerian Food Journal. 2009;27(2):105-110.
20. Lewicki PP. Design of drying systems for food quality optimization. Trends in Food Science & Technology. 2006;17(4):153-163.