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Enhancing A Value Added Product Using Sabari Banana by Drying

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Abstract: *This research investigates the enhancement of Sabari bananas into a shelf-stable, value-added product using oven and sun drying methods. Sabari bananas, known for their rich flavor and nutritional profile, were dried under controlled and natural conditions to analyze their effectiveness in moisture reduction, texture preservation, nutrient retention, and energy efficiency. The study found solar drying to retain up to 70% moisture removal with 12% efficiency, while sun drying achieved only 40% moisture removal with lower efficiency (2.33%). Sensory and nutritional evaluations revealed that solar drying better preserved taste, texture, and vitamins (C and B6). The findings offer a sustainable alternative to commercial drying methods, with potential benefits for local agriculture and small-scale food industries.*

Keywords*:* Sabari banana, value addition, solar drying, sun drying, moisture content, nutritional retention, sustainable food processing

I. INTRODUCTION

Bananas are globally significant fruits, providing food security, income, and environmental benefits. Among various cultivars in India, **Sabari bananas** are underutilized despite their sweet flavor and high nutritional content. Traditional preservation methods often result in reduced quality and high wastage. This study explores **solar and sun drying** to create **crispy, nutritious banana snacks** and extend shelf life while retaining flavor and nutrients.

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II. SYSTEM OVERVIEW

The system designed for this research integrates two distinct banana drying techniques—**oven drying, solar drying** and **sun drying**—to evaluate their effectiveness in producing a value-added product from Sabari bananas. Each method was configured with parameters critical to optimizing drying efficiency, nutritional retention, and product quality.

2.1. Oven Drying System

The oven drying system consisted of a programmable drying oven with adjustable temperature (50°C–70°C), air circulation (low to high), and time settings (6 to 18 hours). Sabari banana slices, uniformly cut to 2 cm thickness, were placed on mesh trays allowing uniform heat flow. The system was designed to:

- Control temperature and air flow precisely,
- Minimize moisture retention,
- Ensure consistent dehydration with minimal nutrient loss.

2.2. Solar Drying System

The solar drying system is a **passive and eco-friendly setup** designed to utilize **solar energy** for dehydrating Sabari banana slices. The system consists of a **wooden drying chamber** equipped with reflective surfaces and a transparent

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glass top that allows maximum sunlight penetration and heat retention. It incorporates a **DC-powered CPU fan**, driven by a **solar photovoltaic panel**, to circulate hot air uniformly throughout the chamber.

2.3. Sun Drying System

The sun drying setup involved placing banana slices on wire mesh trays exposed to natural sunlight. A transparent plastic cover was used to protect the samples from contaminants while maintaining internal humidity and temperature. Key components included:

- Manual rotation for even exposure,
- Temperature and humidity sensors to record real-time conditions,
- A control sample exposed to ambient air for baseline comparison.

2.4. Comparative Parameters

Both systems were evaluated based on:

- Moisture reduction capacity,
- Energy usage and efficiency,
- Retention of sensory and nutritional properties,
- Drying time and environmental sustainability.

This dual-system overview forms the backbone of the comparative study, demonstrating how controlled and natural drying approaches impact the conversion of fresh Sabari bananas into shelf-stable, high-quality food products.

2.6. Solar Drying System

Figure 1. Solar Drying System

2.5 Sun Drying System

Figure 2. Sun Drying System

2.6 Oven Drying System

Figure 3. Oven Drying System

III. HARDWARE COMPONENTS

3.1. Oven Drying System

Programmable Drying Oven

- Temperature range: 50 °C – 70 °C
- Adjustable air-flow (low/medium/high)
- Digital timer (6–18 h)

Stainless-steel Mesh Trays

- Corrosion-resistant, allows uniform air circulation

Digital Thermocouples

- ±0.1 °C accuracy, placed at multiple tray levels

Hygrometer

- Relative humidity sensor for chamber monitoring

Digital Precision Balance

- Capacity 2 kg, readability 0.01 g for weight-loss measurements

3.2. Solar (Wooden-Box) Drying System

Insulated Wooden Box

- Internal dimensions ~55 cm × 40 cm × 30 cm
- Inner surfaces lined with reflective aluminum foil

Tempered Glass Top

- Traps solar heat while allowing visible light

CPU Cooling Fan

- 12 V DC brushless fan for forced air circulation

Solar Photovoltaic Panel

- 20 W, 12 V output to power the fan directly

Temperature & Humidity Logger

- Combined sensor module with data-logging capability

3.3. Sun Drying System

Wire-Mesh Drying Rack

- Galvanized steel, allows 360° airflow

Protective Cover

- UV-stable transparent plastic sheet to block insects/dust

Manual Rotating Stand

- Simple turntable to ensure even sun exposure

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Portable Thermometer-Hygrometer

- Hand-held unit for spot checks

3.4. Auxiliary & Sample Handling

Airtight Sample Containers

- Food-grade plastic, to store dried samples

Labeling Materials

- Waterproof markers and date-coded stickers

Notebook or Tablet

- For manual recording of observations and weights

Table 1. Hardware Components Used

S.No.	Drying Method	Component	Description
1	Oven Drying System	Programmable Drying Oven	Controlled temperature (50–70 °C), airflow settings, and timer (6–18 hours)
2	Solar Drying System	Insulated Wooden Box	Internal aluminum lining to reflect and retain heat
3	Sun Drying System	Wire-Mesh Drying Rack	Open mesh rack for natural air and sun exposure

IV. SYSTEM OPERATION

The operation of the drying systems began with selecting and slicing fresh Sabari bananas into uniform 2 cm pieces, which were then weighed before drying. For solar drying, the slices were placed inside an insulated wooden box lined with aluminum foil and covered with a transparent glass sheet to trap solar heat. A 12V CPU fan, powered by a 20W solar panel, ensured continuous airflow for uniform drying. In sun drying, banana slices were arranged on wire mesh racks exposed to direct sunlight and covered with a UV-stable plastic sheet for hygiene, with trays manually rotated to ensure even drying. Temperature and humidity inside both systems were monitored hourly using sensors, and external weather conditions were also recorded. Solar drying typically required 6–7 hours per day over multiple days to reduce moisture to approximately 12%, whereas sun drying took around 32 hours due to ambient limitations. After drying, the slices were cooled, reweighed, and stored in airtight containers for analysis. Efficiency, water removal rate, and energy consumption were then calculated to evaluate the effectiveness of each method.

V. RESULTS

The results of the study demonstrated that solar drying was more effective than traditional sun drying in producing a high-quality, value-added product from Sabari bananas. Solar drying achieved a moisture reduction of approximately 70%, with an energy efficiency of 11.96%, compared to only 40% moisture reduction and 2.33% efficiency in sun drying. The solar-dried bananas exhibited a crisp texture, sweet flavor with mild caramelization, and retained essential nutrients such as potassium, Vitamin C, and Vitamin B6 better than the sun-dried samples. Sensory evaluation results indicated that the solar-dried product was preferred by most panelists due to its improved taste, texture, and appearance. Additionally, the shelf life of the solar-dried banana slices extended up to six months when stored in airtight containers, compared to the shorter shelf life of sun-dried counterparts. These results highlight the superiority of the solar drying method in terms of drying performance, nutritional preservation, and overall product acceptability.

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VI. CONCLUSION

In conclusion, this project successfully established that solar drying is a more efficient, sustainable, and nutritionally superior method for producing value-added products from Sabari bananas when compared to traditional sun drying. The controlled environment within the solar dryer, aided by reflective insulation, a transparent glass cover, and forced airflow through a solar-powered fan, allowed for faster and more uniform dehydration, resulting in a 70% reduction in moisture and an energy efficiency of 11.96%. The final product retained essential nutrients such as potassium, vitamin C, and vitamin B6, and exhibited a desirable crisp texture, sweet flavor, and extended shelf life of up to six months. In contrast, sun drying, although cost-effective, showed slower drying rates, inconsistent texture, and lower nutrient preservation due to exposure to external contaminants and environmental fluctuations. The research not only validated the use of renewable solar energy in food processing but also demonstrated its viability for rural and off-grid communities aiming to reduce post-harvest waste and increase income through agro-product diversification. The implementation of this model could be scaled to community-level cooperatives or micro-enterprises, encouraging the adoption of clean energy practices, empowering small-scale farmers, and contributing to food security and economic resilience in banana-producing regions. This study also opens pathways for further research into hybrid drying methods, optimized pretreatment techniques, and flavor or additive integration to develop commercially viable, export-quality dried banana products.

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