

## IMPROVING THE FRUIT DRYING PROCESS USING A SELF-TURNING PALLET CONVECTIVE DRYER

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<https://doi.org/10.5281/zenodo.15730811>

**Abstract:** This article provides information about a self-turning pallet dryer device developed to improve drying processes, reduce drying time, and ensure the quality of dried fruits and vegetables. The device is particularly intended for use by limited liability companies and individual entrepreneurs involved in drying operations as part of farms and food processing businesses.

**Keywords:** pallets, device, drying agent, envelope, technology, efficiency, drying duration, zig-zag motion, energy-efficient, continuous, self-turning pallets. Introduction Today, scientific and technical progress is primarily aimed at creating high-efficiency, energy-saving equipment to obtain high-quality products. Traditionally dried fruits and vegetables often do not fully meet the requirements of the international market. Therefore, it has become a pressing issue to prepare products in accordance with export requirements and to widely adopt innovative technologies. Based on this need, developing new technologies to enhance food safety and food production is of great scientific relevance.

In our country, special attention is being given to designing new, intensive, and energy-efficient drying technologies that can extract maximum moisture content from raw materials during the continuous drying of fruits and vegetables. The focus is on modernizing drying processes and upgrading technological devices to achieve higher productivity and quality.

Current fruit and vegetable drying equipment operates in batch mode, resulting in high thermal losses during the loading and unloading of raw materials. Additionally, since the drying agent's heat is not fully utilized, a large amount of energy is consumed. Products dry unevenly due to limited surface contact with the drying agent, and products can stick to the trays, reducing their quality. To address these issues, a new drying system equipped with self-turning pallets and a continuous feeding mechanism has been developed. This ensures complete exposure of the product to the drying agent, uniform drying, reduced energy use, and improved quality.

The "New Uzbekistan Development Strategy" outlines goals to increase food product volumes and assortments. In this context, research focused on improving food production processes and creating high-performance drying equipment has significant importance.

**Materials and Methods** The proposed dryer consists of a casing, a conical top and bottom (envelope), multiple rows of self-rotating horizontal pallets, a mechanism ensuring parallel rotation, and inlet and outlet nozzles for the drying agent. The casing is shaped as a rectangular parallelepiped, with the drying agent moving at a 180° angle across the chamber. The pallets are mounted with bearings on both sides of the chamber walls.

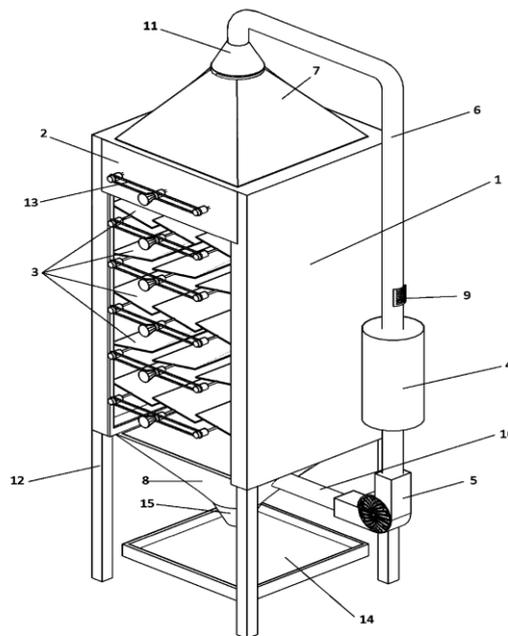
The device is designed to ensure a continuous drying process, uniform product drying through rotation, reduced energy consumption, and increased productivity. These objectives

are achieved through a vertical casing containing rows of horizontally rotating pallets, the inlet and outlet pipes for the drying agent, and a conical hopper with a weighted discharge system.

The goal of the full-factorial experimental plan is to determine the optimal drying regimes for drying plums using the self-turning pallet dryer. The experiments are conducted using a second-order rotatable composite plan.

**Results:** The general layout of the proposed drying device is illustrated in Figure 1. The system functions as follows: raw material is fed through the feeder (2), while the hot air stream enters the drying chamber casing (1) via the inlet nozzle (10) and flows in a zigzag pattern through horizontal pallets mounted at opposing angles ( $5^\circ$ ,  $175^\circ$ ).

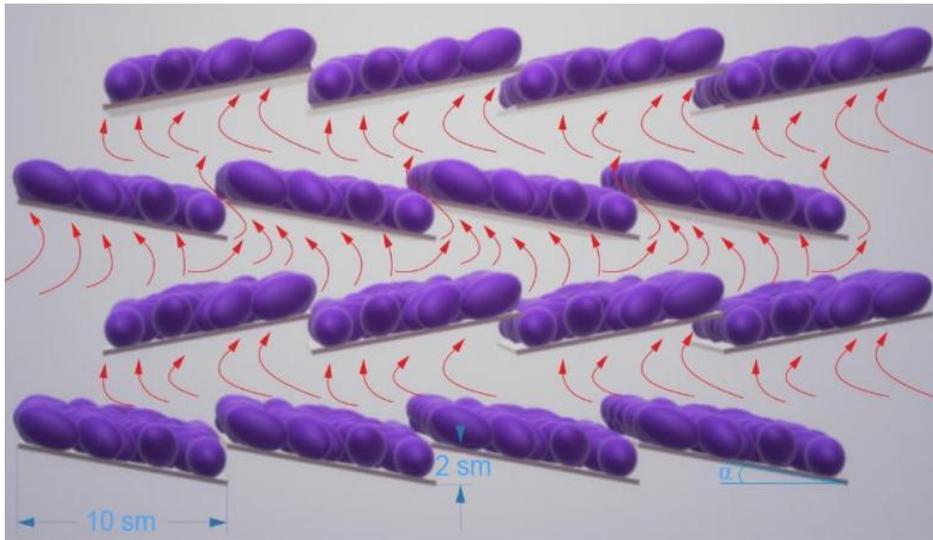
The design enables counterflow between the product and the drying agent. The drying agent, characterized by high temperature, low relative humidity, and high enthalpy, efficiently extracts moisture. Used air exits the chamber through the outlet nozzle (11) or is mixed with fresh air (via damper 9), heated in a calorifier (4), and recirculated into the chamber using a fan (5) and duct



(6).

A conical-shaped lid (7) ensures uniform air distribution, and a similarly shaped bottom (8) collects dried products, which are discharged into pallets using a gravity-based system (15). The dosing system releases product only when a set weight is reached, reducing heat loss.

Due to uniform airflow and continuous pallet rotation, the drying process is highly intensive, and even drying is achieved. The spacing between pallets is optimized to prevent product sticking. Figure 2 illustrates the drying agent flow direction, while Figure 3 shows the placement of fruits on the pallets.



Before operation, airflow across the working channel must be uniform, verified using an anemometer. Improper damper positioning can cause uneven drying. After confirming proper airflow, the heater is run with recirculation fully open and fresh air intake closed. The channel is heated to 80°C, taking 15–50 minutes depending on ambient temperature. Then, product loading begins.

Loading intervals for the first few trays are one hour for plums and 1.5 hours for stone fruits. After loading the seventh tray, the dryer reaches its continuous operating mode. Proper adherence to drying parameters, raw material loading, and interval timing ensures optimal results.

The use of the proposed dryer shortens drying duration by 10–12 hours and reduces the number of defective products by 5% due to reduced sticking. This leads to higher economic efficiency.

**Conclusion:** The proposed continuous self-turning pallet convective dryer ensures uniform drying, energy savings, increased productivity, and high-quality output. It is suitable for both industrial and private sector use and aligns with national development goals

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