

Experimental Data and Mathematical Model of the Thermal Drying of Algerian Apricot Slices (*Prunus armeniaca* L.)

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Article Info:

DOI: 10.22399/ijcesn.5302

Received : 05 March 2026

Revised : 19 May 2026

Accepted : 22 May 2026

Keywords

apricot,
thermal drying,
moisture content,
temperature,
drying kinetics,
sorption isotherms.

Abstract:

This study aims to determine the drying kinetics of three apricot varieties: 'Luizet' (var1), 'Rosé' (var2), and 'Khed Erroumia' (var3), as well as the sorption isotherms of the first two varieties, which are widely cultivated in the Aurès region of Algeria. Drying was performed at temperatures of 30, 40, 50, and 60°C with an air flow rate of 1 m/s, but the isotherms were established for the two temperatures of 30 and 60°C. The moisture content of the fresh apricots, initially ranging from 0.84 to 0.87 kg of water per kg of product, was reduced to values of 0.14 to 0.20 kg of water per kg of product after a drying time of 3 to 5 hours. The experimental work was followed by mathematical modeling using Henderson's Two-Term model, which best fit the drying curves, with a coefficient of determination R^2 ranging from 0.99920 to 0.99994 and the chi-square hypothesis test (χ^2) ranging from 0.000000333 to 0.000015921 depending on the variety and drying temperature. It was observed that the shortest drying time occurred at a temperature of 60°C, with a minimum of only 2.2 hours for variety 3. Sorption isotherms were also modeled, revealing that the Peleg model provides the best performance according to statistical criteria, with a correlation coefficient r ranging from 0.9952473 to 0.9992376 and a standard deviation coefficient s varying from 0.0034976 to 0.0098374 for both varieties, var1 and var2, at the operating temperatures considered.

1. Introduction

Algeria ranks first in Africa and is among the world's top six countries in apricot production [1], with an area allocated to this crop reaching no less than 38,239 hectares in 2023 according to the FAO. Annual apricot production reached approximately 190,000 tons in 2021, 256,771 tons in 2022, and 300,000 tons in 2024. Apricot trees are cultivated in the Aurès region by more than 2,000 producers across 4,500 hectares, representing 25% of the total area devoted to fruit tree cultivation, with production in the municipality of Batna reaching

394,805 quintals of apricots for the 2023–2024 agricultural season.

In addition to its nutritional value, the apricot is widely consumed in Algeria for its proven therapeutic benefits for consumers' health. This fruit is highly perishable due to its high water content—exceeding 82%—and thus requires proper handling after harvest. Producers therefore face a difficult economic situation due to a significant lack of large-scale processing or preservation facilities for their produce in the region. To maximize the value of this important food commodity in local or international markets, it is essential to preserve it

for as long as possible, and drying (particularly solar drying) thus emerges as the most suitable method for minimizing economic losses.

Scientific literature from the past decade reveals a rapid shift from conventional methods (direct solar drying) toward innovative technologies designed to preserve bioactive compounds, color, and organoleptic properties.

The review [2] by Hassanzai et al. (2025) provides a detailed classification of drying technologies used for apricots. Traditional techniques (solar drying, hot air drying) are cost-effective but result in nutritional losses and a deterioration of sensory properties. In contrast, modern methods such as freeze-drying, microwave drying, and vacuum drying ensure better preservation of aromatic compounds, texture, and bioactive compounds [3]. It is worth noting the significant impact of various pretreatments—as demonstrated by several studies conducted prior to drying—on the kinetics and final quality.

Several studies agree that the Wang and Singh model is the most accurate for modeling the natural drying of apricots, with error values below 0.05 [4], and the Page model ($MR = \exp(-kt^n)$) is often preferred for pretreatment [5]. Solar drying [6] appears to be the ideal option for areas with high sunlight exposure, combining nutritional performance and energy efficiency (negligible electricity consumption). However, the choice of the ideal method depends on local constraints (sunlight, investment, production scale), and no universal solution can be recommended. Convective drying represents an intermediate method between conventional approaches (direct solar) and advanced technologies (freeze-drying, radiofrequency). The best-known advantage of this drying method lies in the acceleration of dehydration kinetics compared to natural methods. According to Topcam and Gogus (2022), convective drying at 50–60°C can reach a target moisture content (0.25–0.33 kg water/kg DM) in 6 to 12 hours, depending on the thickness of the apricots. This represents a 10- to 20-fold reduction compared to traditional solar drying. Convective drying of apricots offers significant structural benefits: a notable reduction in drying time compared to conventional techniques, adequate mineral retention, control of enzymatic browning, treatment homogeneity, economic advantages in terms of cost, and adaptability to innovative treatments [7-9]. Its main limitations—energy consumption and loss of flavor—can be partially overcome through hybrid configurations (solar convection drying) or technological combinations (hot air combined with radiofrequency). To test the feasibility of the drying

process on the three most widely cultivated varieties in Algeria, hot-air drying was chosen because it ensures perfectly controlled and reproducible conditions, unlike solar drying, which yields variable results. Compared to freeze-drying (too costly), microwave drying (non-homogeneous), or direct solar drying (non-reproducible), hot-air drying offers precise control while remaining technically and economically accessible, as the region is sufficiently rich in energy resources.

The objective of this study is therefore to provide essential information and predictive tools enabling industry professionals and agricultural cooperatives in the Aurès region to optimally control the dehydration process of their apricots.

2 Materials

2.1 Plant Material

In North Africa, several varieties are found (Figure 1), two of which are specific to Algeria (the Algerian Canino, designated VAR1, and the Rosé, designated VAR2) and are found exclusively in the Aurès Mountains: one in N'Gaous, in the western Aurès, and the other in Menaa, in the central Aurès (southwest of the capital of the Batna town). The Rosé of Menaa variety is unique in the world for its whiteness and red spot. The third variety, designated VAR3, is the Bergarouge of the highlands, known locally as Khed Erroumia. The three varieties of apricots were purchased fresh from a local market in Batna and selected individually on a uniform basis using three criteria: size (medium), degree of ripeness (neither underripe nor overripe), and external appearance (smooth surface without cracks). They were then washed by hand with fresh water to remove impurities, mud, insecticide residues, and other contaminants.

2.2 Facilities

2.2.1 Hot-air dryer

Drying tests were conducted on the GIA-INRA-AgroParisTech pilot dryer in Massy, France (Figure 2), which is automatically regulated and controlled. Air is drawn in by the centrifugal fan 2 and heated by a heating element system 3 (on/off operation), then rises to the cyclone 6. In parallel, steam from the boiler 4 (softened water) may be introduced. The cyclone separates the water droplets to prevent damage to the system (corrosion of equipment). The air then enters at Bypass 13 and can go either outside or into the dryer. It is directed

outside when weighing is performed. The rest of the time, it is sent over a screen 14 to promote mixing and then through a honeycomb 15, which propels the air along a vertical axis. These two systems create an artificial pressure drop and a uniform piston flow to ensure uniform drying across both diameter and height. Weighing is performed at set intervals: the support 17 for the product to be dried (sieve) descends and rests on a system (tripod) connected to the scale 21, then rises again. Sensors are positioned at various points on the system (7–12, 16, 18, and 19) and connected to a computer that issues commands and collects data. The system can operate automatically or manually. Signals are transmitted at high levels (several amps) and then attenuated by solid-state relays so that the computer can receive them without being damaged. Safety systems are in place: thermostat 7, which shuts down operation if the temperature in the pipes is too high, and regulators in the control boxes to minimize high electrical signals and readjust temperatures to set points. The principle of a thermocouple (8, 10, 16, and 18) involves measuring the electromotive force (expressed in microvolt) between two wires made of different materials. This measurement is proportional to the temperature and the length of these wires, hence the need for calibration. Additionally, this system is sensitive to stray currents. In the food industry, the use of Pt100 probes (11) is generally preferred; their principle involves measuring resistance, which changes with temperature. The length of the tube does not affect the measurement, and this system is also insensitive to stray currents. Control must be applied to three variables:

- Temperature: the computer calculates the heat flux ($\square$ [kW]) required to reach the set point and distributes the energy among the heating elements that warm the air and the controller to fine-tune the system in response to disturbances (Pt100 sensor).
- Air velocity: Pitot tube 9 provides information on the air flow rate and, consequently, the air velocity $V_{\text{(air)}}$, and control is achieved via a variable-speed drive on fan 2.
- Relative air humidity H_r : The water vapor inlet is controlled by a solenoid valve 5 at the outlet of the boiler 4.

2.2.2 Thermostatic Ovens

Regarding desorption isotherms, two thermostatic ovens (Figure 3) located in the same laboratory (model V049 BLANC-LABO) are used to conduct the experiments yielding their profiles.

3. Methods

Approximately 5 kg of each variety is prepared for drying tests and transported the day before harvest to the laboratory where the pilot hot-air dryer is located. An experimental protocol was developed to determine the sorption isotherms as well as the drying kinetics of each variety. A diagram (Figure 4) of the drying loop for this device is displayed on the interface screen of the program designed to control the dryer via computer. The operating conditions—temperature, airflow rate, and relative humidity of the drying air—as well as the termination criteria for each drying test are pre-programmed on the control computer. Data records are automatically saved to XML files using LabVIEW software. The apricots used are carefully selected, washed, dried, pitted with a knife, and then cut into small rectangular pieces with 1 cm sides (Figure 5). The resulting apricot slices are weighed and placed on a sieve inside the drying chamber, while the tare weight is recorded using a high-precision Mettler scale (0.001 g). To ensure the repeatability of the experiments, three samples of each variety are prepared to determine the drying kinetics and sorption isotherms programmed in the laboratory. Data from each drying run are recorded by computer (the conditions of relative humidity, temperature, and drying air velocity are known in advance, as are the times for weighing the weight loss of the product to be dried and the end of the operation). The drying of the three apricot varieties was carried out at temperatures of 30°, 40°, 50°, and 60°C and a gentle drying air velocity of 1 m/s, thereby respecting the sensitivity of this food to thermal effects. The moisture contents (X_h) determined on a wet basis using a drying oven by holding the apricot samples at 105°C for 24 hours, were as follows: 0.87 [kg of water/kg of fresh apricot] for variety VAR1, or 6.692, and 0.84 [kg of water/kg of fresh apricot] for varieties VAR2 and VAR3, or 5.25 [kg H₂O/kg DM], according to the following formula:

$$X = \frac{X_h}{1 - X_h}$$

(1)

Where:

X : dry matter water content [kg H₂O/kg DM]

X_h : moisture content on a wet basis [kg water/kg wet product]. During each experiment, the mass m of each apricot sample in the drying chamber, the wet temperature T_h , the temperatures T_{a1} and T_{a2} , and the relative moistures H_{a1} and H_{a2} are recorded at each time t , and the data are

automatically acquired and entered into spreadsheets for subsequent calculations and modeling. At each time t , the water content X (dry basis) is calculated based on the mass m of the product measured according to the following equation:

$$X = \frac{m - m_s}{m_s} \quad (2)$$

Where:

m : mass of the product in g.

m_s : dry matter mass

m_s = total initial mass – initial mass of water

The instantaneous drying rate at time t is given by:

$$\frac{dX}{dt} = \frac{X(t - \Delta t) - X(t)}{\Delta t} \quad (3)$$

Where:

dX/dt : drying rate in [kg H₂O/kg DM/sec.]

Δt : time interval in seconds.

At the end of the experiment, a new measurement of the product's moisture content on a wet basis is taken using the drying cell to determine the final moisture content of the products. To track the progress of drying over time, the moisture ratio MR (dimensionless value) is calculated to normalize the data using the following formula:

$$MR = \frac{M_t - M_e}{M_0 - M_e} = \frac{X_t - X_e}{X_0 - X_e} \quad (4)$$

Where: M_t is the moisture content at time t in (kg H₂O/kg DM), M_0 is the initial moisture content, and M_e is the equilibrium moisture content. The values of M_e are relatively small compared to M_t or M_0 , so the error introduced by simplifying it is negligible (Diamante and Munro, 1993), hence equation (4) is reduced to:

$$MR = \frac{M_t}{M_0} \quad (5)$$

4. Results and Discussion

4.1 Influence of drying parameters

The experimental curves showing the change in moisture content over time for the thin-layer drying of the three apricot varieties at different temperatures (30, 40, 50, and 60 °C) and an air

velocity of 1 m/s are shown in Figure (6). As can be seen, the increase in drying temperature led to a significant increase in drying rate, which consequently reduced the drying time from 4.4 to 2.2 hours for the Canino variety (VAR1), for example. The curves generally showed steady-state drying behavior, controlled by diffusion, under all test conditions. The change in moisture content over time at a drying temperature of 60°C for the three varieties is illustrated in figure 7, where it is observed that the variety most suitable for drying is the Canino variety (VAR1).

4.2 Mathematical Modeling of Drying Curves

The drying curves obtained for the three varieties are fitted using ten mathematical models (Doymaz et al.) listed in this table: Regression analysis was performed using the statistical software Statistica Stasoft, and the quality of the fit of the mathematical models tested to the experimental data was evaluated based on the coefficient of determination R^2 and the reduced chi-square χ^2 between the experimental and predicted values. The reduced chi-square is calculated as follows:

$$\chi^2 = \frac{\sum_{i=1}^N (MR_{exp,i} - MR_{pre,i})^2}{N - z} \quad (6)$$

Where: $MR_{exp,i}$ is the experimental moisture content, $MR_{pre,i}$ is the predicted moisture content, N is the number of observations, and z is the number of constants in the mathematical model (Table 1). The best estimates of these curves are obtained by taking the largest value of R^2 and the smallest value of the χ^2 (Ozdemir and Devers, 1999). According to the statistical table (2) generated using the statistical analysis and calculation software STATISTICA (STASOFT), the Henderson model (Tow Term) is adopted, and the difference between the predicted and experimental values is shown in Figure (8).

4.3 Development of desorption isotherms

Desorption isotherms are essential for understanding and modeling food drying processes by determining the product's optimal equilibrium moisture content X_e . Determined experimentally using the static method and modeled using one of the four models selected and listed in Table (2), they allow us to predict the product's equilibrium water content, which is essential for optimizing drying and establishing appropriate storage and preservation conditions for apricots. The correlation coefficient r (eq 5) and the standard error s (eq 6) are calculated as statistical criteria to minimize the difference between the calculated moisture content

X_{cal} and the experimentally obtained moisture content X_{exp} , and are given by:

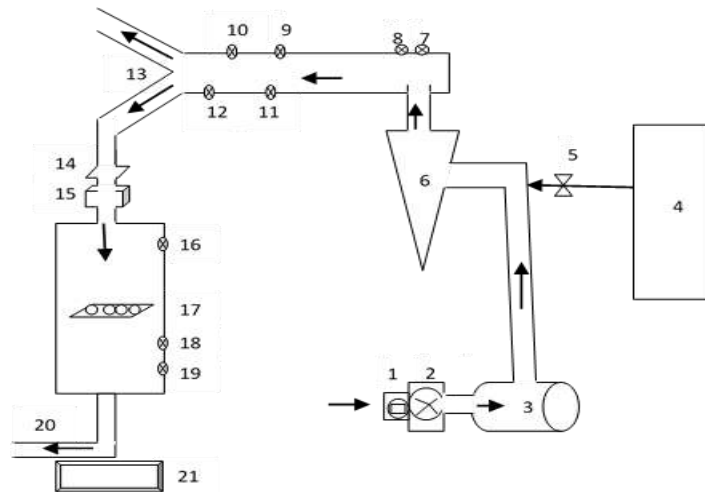
$$r = \sqrt{1 - \frac{\sum_{i=1}^N (y_{i,exp} - y_{i,cal})^2}{\sum_{i=1}^N (\bar{y}_{exp} - y_{i,exp})^2}} \quad (5)$$

$$s = \sqrt{\frac{\sum_{i=1}^N (y_{i,exp} - y_{i,cal})^2}{N - n}} \quad (6)$$

The desorption isotherms in Figure (9) were obtained for two varieties: Canino VAR1 and Rosé VAR2, and for temperatures of 30 and 60°C, using seven saturated salt solutions: LiCl; MgCl₂; NaBr; KI; NaCl; KCl; K₂SO₄ to obtain seven data points on the curve of the equilibrium concentration X_e as a function of H_r (w_a). The model that best fits the desorption curves is adapted for the smallest values of r and s and according to calculations performed using CurvExpert (Table 3). Regarding the values of r and s , Peleg's model is the best model for fitting the observed desorption isotherm curves.



Algerian Canino (Louzi) from N'Gaus VAR1 Rosé de Mena VAR2 Khed Eroumia (Bergarouge) VAR3
Figure 1: Apricot varieties produced in Batna (Algeria).



1-Motor; 2- Fan; 3- Heating element; 4- Boiler; 5- Solenoid valve; 6- Cyclone; 7- Thermostat; 8- Thermocouple T_{A1} ; 9- Pitot tube; 10- Thermocouple; 11- Pt100; 12- H_{rA1} ; 13- Bypass; 14- Grate; 15- Honeycomb; 16- Thermocouple; 17- Screen (product support); 18- Thermocouple T_{A1} ; 19- H_{rA1} ; 20-Air outlet; 21- Scale.

Figure 2. Diagram of the drying system.



Figure 3. Diagram of the oven used for desorption isotherms.

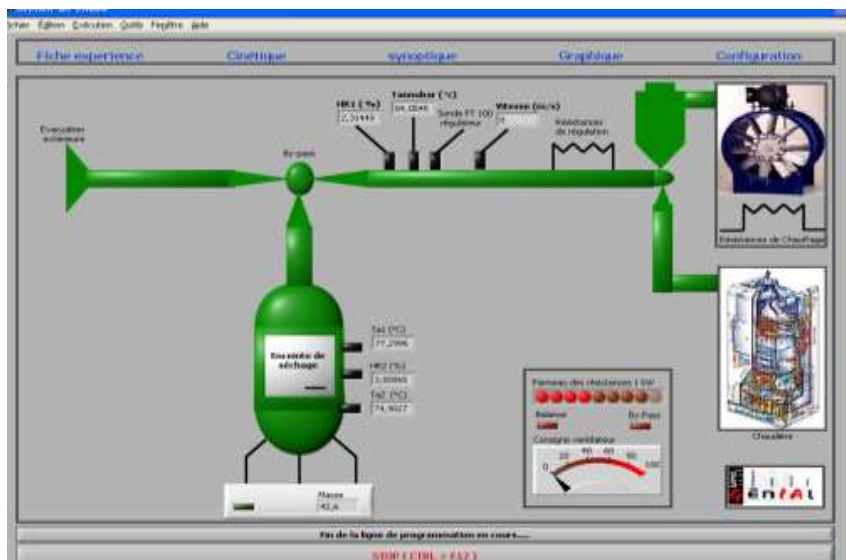


Figure 4. Diagram of the pilot dryer's program interface.

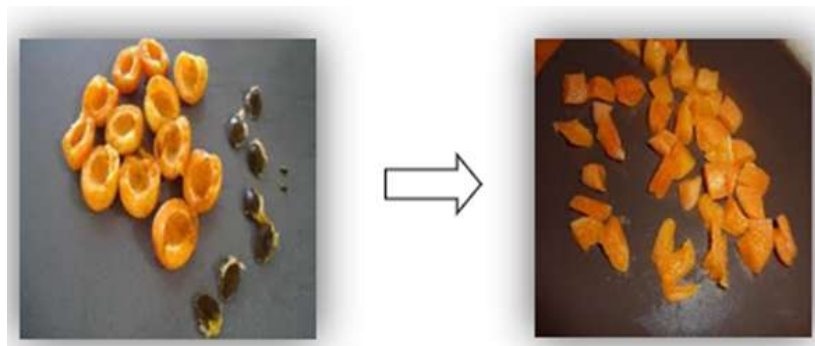


Figure 5. Pitting and cutting apricots into 1-cm-thick slices.

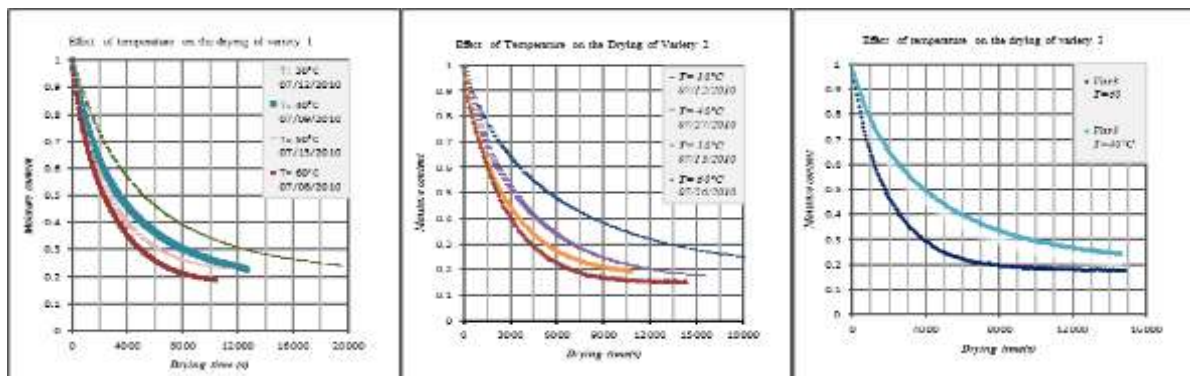


Figure 6. Change in moisture content over time for different temperatures.

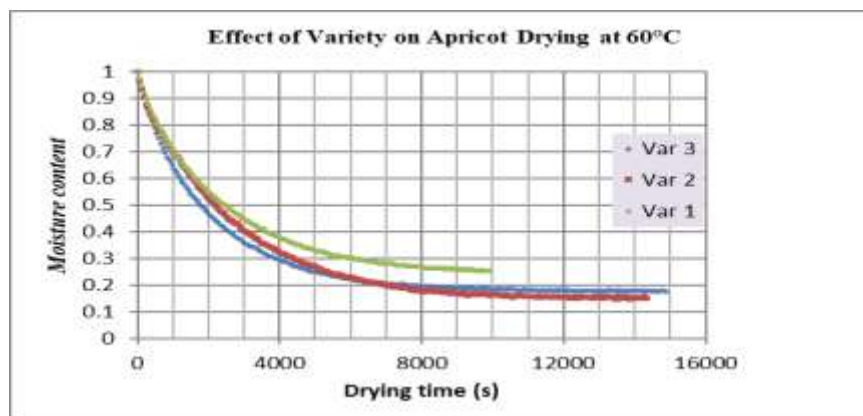


Figure 7. Change in moisture content over time for different varieties.

Table 1. Mathematical models.

Model Name	Model	Reference
Lewis	$MR = \exp(-kt)$	Lewis (1921)
Henderson and Pabis	$MR = a \exp(-kt)$	Henderson and Pabis (1961)
Page	$MR = \exp(-kt^n)$	Kashaninejad and Tabil (2004)
Modified Page	$MR = \exp(-(-kt)^n)$	Overhults et al. (1973)
Logarithmic	$MR = a \exp(-kt) + c$	Yagcioglu et al. (1999)
Two-term (Henderson)	$MR = a \exp(-k_0 t) + b \exp(-k_1 t)$	Henderson (1974)
Two-term exponential	$MR = a \exp(-kt) + (1-a) \exp(-kat)$	Sharaf-Elden et al. (1980)
Approximation of diffusion	$MR = a \exp(-kt) + (1-a) \exp(-kbt)$	Yaldiz and Ertekin (2001)
Verma et al	$MR = a \exp(-kt) + (1-a) \exp(-gt)$	Verma et al. (1985)
Wang and Singh	$MR = 1 + at + bt^2$	Wang and Singh (1978)

Table 2. Values of statistical criteria.

Model	T (°C)	R ²			χ^2		
		Var1	Var2	Var3	Var1	Var2	Var3
Lewis	30	0.97274	0.96428	0.99113	0.000161442	0.000193045	0.000059684
	40	0.98150	0.97592	0.96619	0.000120107	0.000155508	0.000203203
	50	0.97434	0.98301	-	0.000171093	0.000116439	-
	60	0.99458	0.98356	0.94055	0.000041978	0.000103933	0.000317084
Henderson and Pabis	30	0.98384	0.98221	0.99562	0.000095995	0.000096372	0.000029638
	40	0.98887	0.98652	0.98111	0.000072635	0.000087469	0.000113956
	50	0.98285	0.98901	-	0.000114962	0.000075727	-
	60	0.99662	0.99187	0.94941	0.000026451	0.000051661	0.000270859
Page	30	0.99824	0.99914	0.99562	0.000010456	0.000004619	0.000029557
	40	0.99960	0.99992	0.99920	0.000002638	0.000000490	0.000004862
	50	0.99874	0.99946	-	0.000008502	0.000003667	-
	60	0.99988	0.99994	0.98571	0.000000994	0.000000397	0.000076554
Modified Page	30	0.99824	0.99914	0.99562	0.000010456	0.000004619	0.000029557
	40	0.99960	0.99992	0.99920	0.000002638	0.000000490	0.000004862
	50	0.99874	0.99946	-	0.000008502	0.000003667	-
	60	0.99988	0.99994	0.98571	0.000000994	0.000000397	0.000076554
Logarithmic	30	0.99856	0.99776	0.99588	0.000008534	0.000012173	0.000027884
	40	0.99770	0.99538	0.99692	0.000015044	0.000030053	0.000018652
	50	0.99772	0.99786	-	0.000015407	0.000014781	-
	60	0.99814	0.99788	0.99872	0.000014579	0.000013545	0.000006931
Tow-term	30	0.99978	0.99974	0.99766	0.000001256	0.000001405	0.000015921
	40	0.99994	0.99984	0.99946	0.000000333	0.000001032	0.000003259
	50	0.99934	0.99930	-	0.000004444	0.000004831	-
	60	0.99994	0.99966	0.99920	0.000000409	0.000002131	0.000004318
Tow-term exponential	30	0.99598	0.99482	0.99758	0.000023876	0.000028061	0.000016414
	40	0.99894	0.99740	0.99412	0.000006965	0.000016920	0.000035426
	50	0.99536	0.99836	-	0.000031033	0.000011284	-
	60	0.99990	0.99942	0.96782	0.000000842	0.000003640	0.000172283
Approximation of diffusion	30	0.99974	0.99968	0.99740	0.000001580	0.000001751	0.000017559
	40	0.99994	0.99984	0.99940	0.000000371	0.000001054	0.000003597
	50	0.99928	0.99926	-	0.000004846	0.000005060	-
	60	0.99994	0.99964	0.99904	0.000000407	0.000002247	0.000005163
Verma et al.	30	0.99974	0.99968	0.99766	0.000001580	0.000001751	0.000015880
	40	0.99994	0.99984	0.99940	0.000000371	0.000001054	0.000003597
	50	0.99928	0.99926	-	0.000004846	0.000005060	-
	60	0.99994	0.99964	0.99904	0.000000407	0.000002247	0.000005163
Wang and Singh	30	0.93574	0.95279	0.95142	0.000381848	0.000255934	0.000328483
	40	0.94612	0.92158	0.93051	0.000369364	0.000508818	0.000419252
	50	0.91983	0.93752	-	0.000537537	0.000430456	-
	60	0.93642	0.96528	0.72122	0.000601391	0.000220780	0.001492958

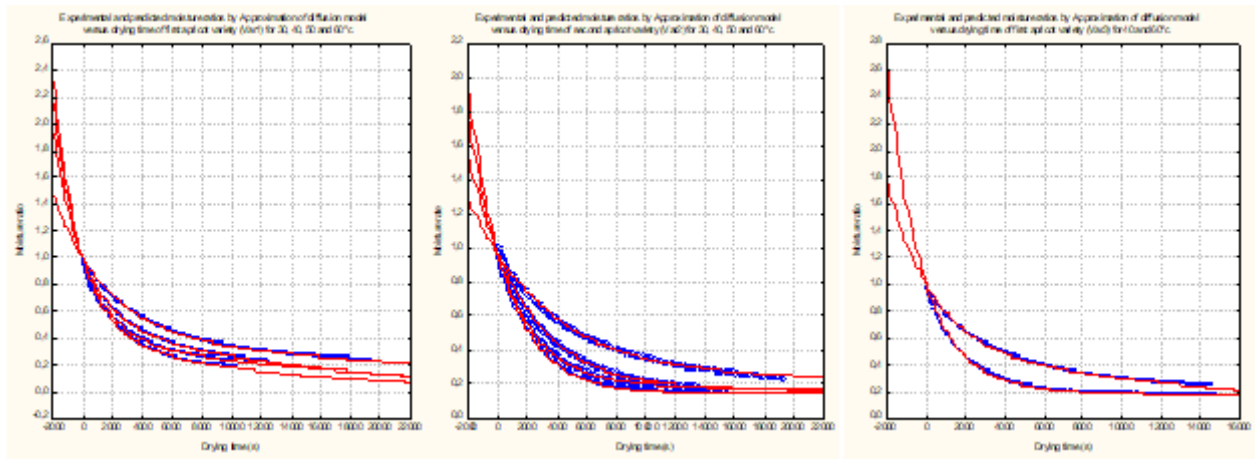


Figure 8: Theoretical curves compared to experimental ones.

Table 2. Selected models for describing sorption isotherms.

Model	Expression	Parametrs
Langmuir	$X_e = 1 / (A + Ba_w^{C-1})$	A, B, and C
BET	$X_e = \frac{ABa_w}{(1 - a_w)[1 + (A - 1)a_w]}$	A and B
GAB	$X_e = \frac{CABa_w}{(1 - Ba_w)(1 - Ba_w + ABa_w)}$	A, B, and C
Peleg	$X_e = Aa_w^B + Ca_w^D$	A, B, C, and D

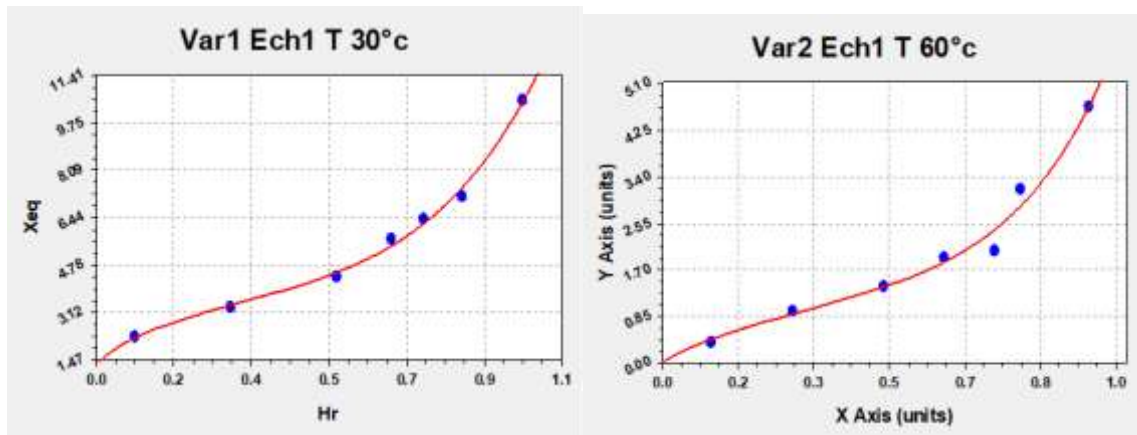


Figure 9: Theoretical vs. experimental desorption isotherm curves.

Table 3: Identification of statistical model parameters.

Model	T(°C)		Var1		Var2	
		Parameter	Ech1	Ech2	Ech1	Ech2
Langmuir	30	r	0.9900629	0.9745615	0.9896873	0.9795717
		s	0.0143155	0.0196075	0.0130602	0.0182973
		a	26.17996	-169.5351	-147.50796	-212.28686
		b	29.474268	172.9654	150.87118	215.52227
		c	0.7567574	0.9543311	0.9482857	0.9715640
	60	r	0.9628371	0.9901742	0.9945496	0.9954258
		s	0.0300842	0.0108490	0.0116137	0.0072439
		a	3.1482422	-179.10355	-80.398336	-78.193317
		b	0.4887774	182.96186	83.215532	82.280682
		c	-0.8166202	0.95053574	0.86549514	0.8493320
Brunauer Emett		r	1.1874483	1.3964965	0.9137396	1.6463462
		s	0.1413511	0.1344037	0.0331332	0.1567631

Teller (BET)	30	<i>a</i>	0.0014974	0.00166929	-161.13741	0.0022441
		<i>b</i>	-2.6730309	-2.4788911	-0.0015251	-2.238254
	60	<i>r</i>	0.9030346	2.1655119	0.9843367	0.9924233
		<i>s</i>	0.0427975	0.1655168	0.0175642	0.0083324
		<i>a</i>	124.51189	-0.0009007	7.3765757	7.4053727
		<i>b</i>	0.0025722	0.00000004	0.02684821	0.0210271
Guggenheim Anderson de Boer (GAB)	30	<i>r</i>	0.9687644	0.9946515	0.9955913	1.5125055
		<i>s</i>	0.0252444	0.0090363	0.0085519	0.1649793
		<i>a</i>	0.0681634	0.0674244	0.0676485	0.0858133
		<i>b</i>	0.7932908	0.7845529	0.7888414	-0.055840
		<i>c</i>	1.4967833	-9,628,204.4	-4.198711	86.916882
	60	<i>r</i>	0.8323032	0.9958230	0.9847586	0.9928520
		<i>s</i>	0.0617451	0.0070836	0.0193732	0.0090495
		<i>a</i>	0.1077920	0.0576415	0.0542224	0.0433649
		<i>b</i>	0.6895956	0.7990994	0.8604648	0.8403105
		<i>c</i>	-1.205816	-1.067690	1.1479054	7.0653954
Peleg	30	<i>r</i>	0.9986508	0.9952473	0.9978492	0.9990886
		<i>s</i>	0.0061040	0.0098374	0.0069011	0.0044847
		<i>a</i>	0.1838559	0.1267340	0.1691958	0.1635052
		<i>b</i>	0.2313088	0.1813193	0.1392493	0.1697798
		<i>c</i>	32.728543	0.2728843	4.7093311	5.5415074
		<i>d</i>	0.8861816	4.8494408	0.3791476	0.34901845
	60	<i>r</i>	0.9446689	0.9992376	0.9966523	0.9989425
		<i>s</i>	0.0421909	0.0034976	0.0105154	0.0040253
		<i>a</i>	0.1520624	0.1277279	0.0935980	0.1436712
		<i>b</i>	0.1520600	0.1466057	0.2510231	0.1076431
		<i>c</i>	0.7102188	0.4256003	0.3907662	5.4043880
		<i>d</i>	0.7256753	5.3082014	3.9854145	0.5488938

5. Conclusions

The pilot-scale through-flow dryer and the thermostatic ovens successfully established the drying kinetics and desorption isotherms for three varieties of Algerian apricots. The absence of pretreatment reflects the natural behavior of the fruit.

The effect of temperature on the kinetics is confirmed: 60 °C results in the shortest drying time. The observed drying phase is exclusively decreasing, which is consistent with moisture transfer controlled by internal diffusion.

The Canino variety (Var1) exhibits the highest drying rate (2.2 hours at 60 °C compared to 3.1 and 3.4 hours for Var2 and Var3, respectively), making it a good candidate for energy-efficient production. This work makes an original and useful contribution to the apricot industry in Algeria, as it characterizes three local varieties from the Aurès region for the first time. The validated mathematical models—Henderson (Two Term) for drying and Peleg for sorption—now make it possible to predict the product's behavior without repeated destructive testing.

These results provide a solid scientific basis for the design of dryers suited to small-scale producers in the Aurès region and for the industrial processing of local apricots into high-quality dried fruit.

Author Statements:

- **Ethical approval:** The conducted research is not related to either human or animal use.
- **Conflict of interest:** The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper
- **Acknowledgement:** The authors declare that they have nobody or no-company to acknowledge.
- **Author contributions:** The authors declare that they have equal right on this paper.
- **Funding information:** The authors declare that there is no funding to be acknowledged.
- **Data availability statement:** The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.
- **Use of AI Tools:** The author(s) declare that no generative AI or AI-assisted technologies were used in the writing process of this manuscript.

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