

OBJECTIVES

- Influence of air temperature and velocity on drying kinetics of grapes.
- Mathematical modeling of drying kinetics.

INTRODUCTION

- Several authors studied the effects of different drying conditions.
- Some common models used to fit experimental data are:

A) The Exponential model (Newman et al., 1996):

$$\frac{M - Me}{Mo - Me} = \exp(-Kt)$$

B) Two simplified forms of Fick's diffusion equation:

$$\frac{M - Me}{Mo - Me} = \frac{6}{\pi^2} \exp\left(\frac{-\pi^2 Dt}{r^2}\right) \quad \frac{M}{Mo} = \frac{6}{\pi^2} \exp\left(\frac{-\pi^2 Dt}{r^2}\right)$$

C) The two-compartment diffusion model developed by Glenn (Madamba et al., 1996):

$$\frac{M - Me}{Mo - Me} = A_0 \exp(-k_0 t) + A_1 \exp(-k_1 t)$$

MATERIALS & METHODS

- Dominga grapes blanching in water at 100°C during 30s



- On-line acquisition { total weight, air temperature, air relative humidity
- Measurement { Air velocity, Initial water content

RESULTS & DISCUSSION

- A single falling-rate behavior was observed.
- Air velocity in the tested range, has no significant effect. ↔ internal diffusion
- The air temperature effect follows the Arrhenius law: $K = K_0 \exp\left[-\frac{Ea}{R} \left(\frac{1}{T} - \frac{1}{T_0}\right)\right]$

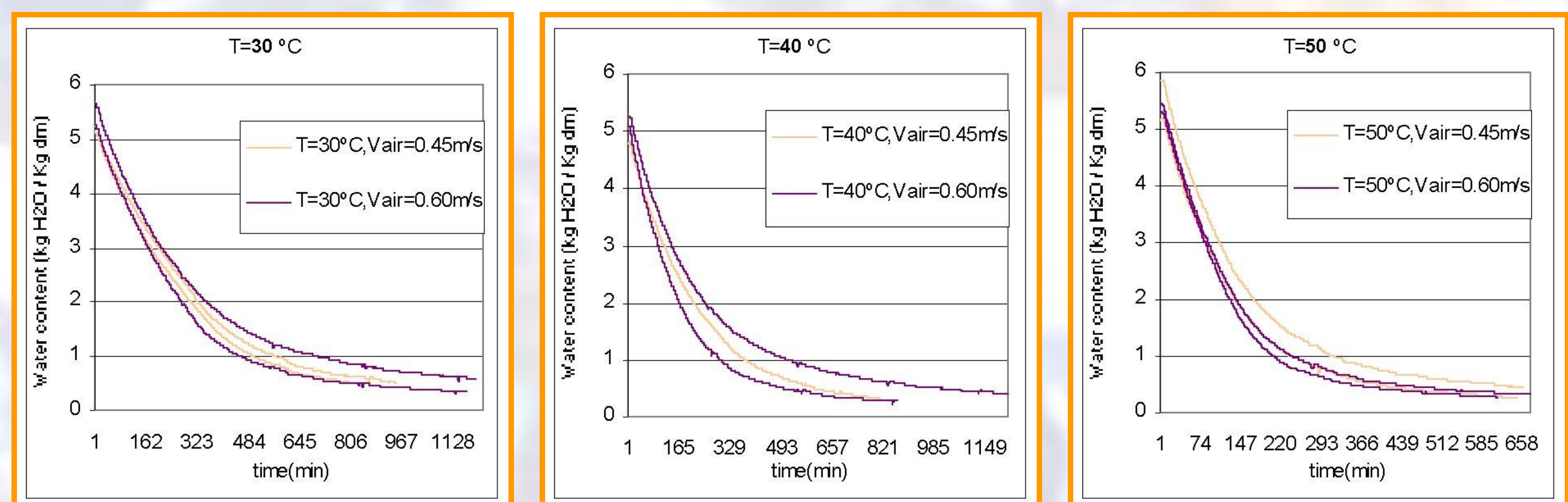


Fig. 1 - Effect of air velocity on drying kinetics of Dominga grapes (experimental data).

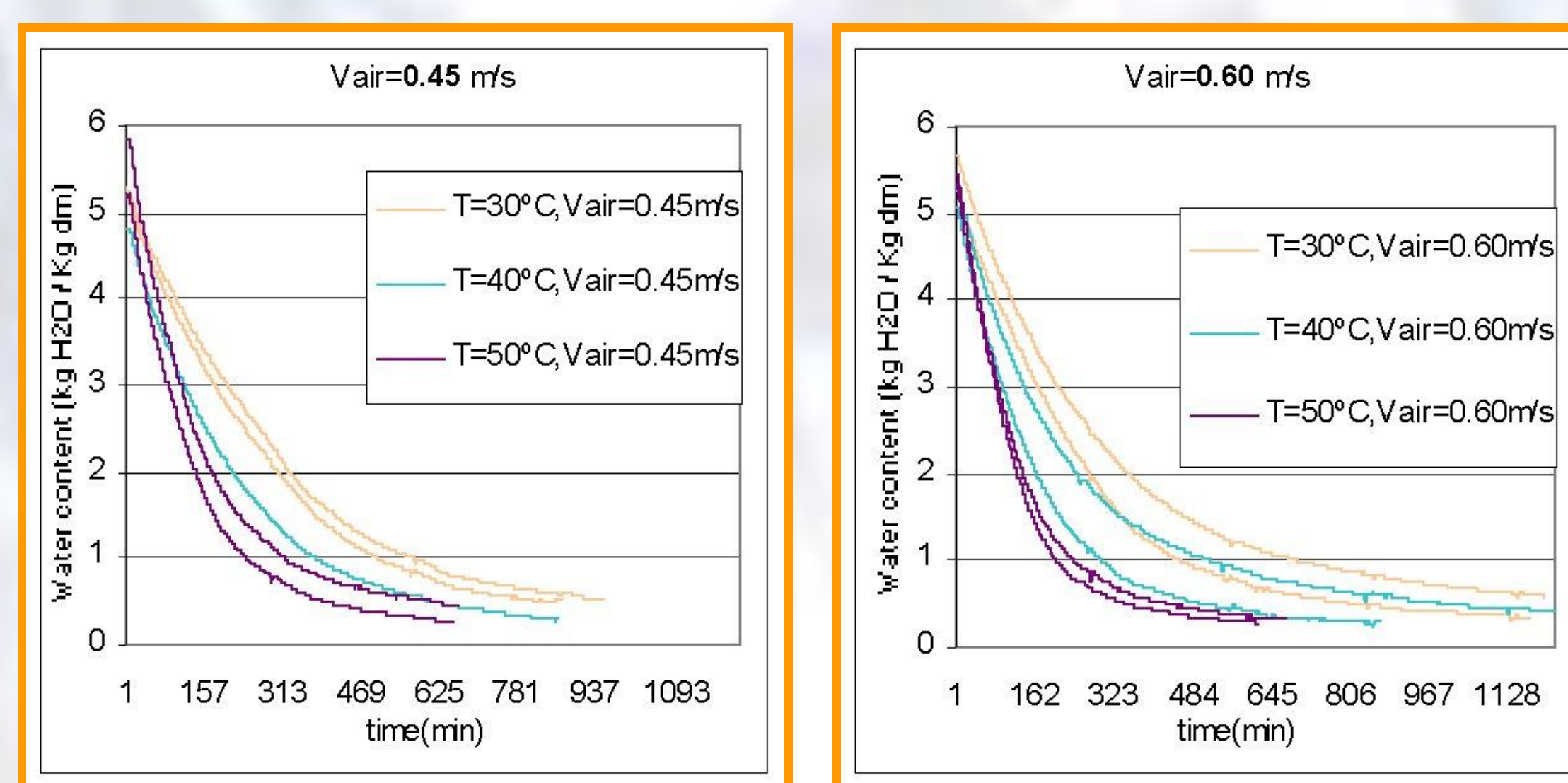


Fig. 2 - Effect of air temperature on drying kinetics of Dominga grapes (experimental data).

Tab. 1 - Model parameters and corresponding experiments.

Experiment no.	T (°C)	V _{air} (m/s)	K (min ⁻¹)	Me (kg/kg dm)	r ²
1	30	0.45	0.0006563	0.0939	0.9993
2	50	0.45	0.001413	0.4201	0.9995
3	40	0.45	0.0008827	0.1736	0.9997
4	30	0.45	0.0006237	0.1762	0.9992
5	50	0.45	0.001479	0.2226	0.9987
6	30	0.60	0.000778	0.2613	0.9984
7	50	0.60	0.001663	0.2174	0.9968
8	40	0.60	0.001227	0.2613	0.9993
9	50	0.60	0.001573	0.2970	0.9985
10	30	0.60	0.0007049	0.5398	0.9999
11	40	0.60	0.0008954	0.4690	0.9994

- A one-step non-linear regression (Arabshahi and Lund), was performed simultaneously to all the data:

- Activation Energy = 31.8 ± 0.3 kJ/mol
- Mean equilibrium moisture content = 0.338 ± 0.007 kg water/kg dry mater

LITERATURE:

Arabshahi, A. and Lund, D. B., 1985, Considerations in calculating kinetic parameters from experimental data, Journal of Food Process Engineering, (7), 4, pp. 239-251.
Madamba, P. S., Driscoll, R. H. and Buckle, K. A., 1996, The thin layer drying characteristics of garlic slices, Journal of Food Engineering, 29, pp. 75-97.
Newman, G. M., Price, W. E. and Woolf, L. A., 1996, Factors influencing the drying of prunes. 1. Effects of temperature upon the kinetics of moisture loss during drying, Food Chemistry, (57), 2, pp. 241-244.

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