

Thin-layer drying characteristics and modeling of pistachio nuts

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Abstract

Thin-layer drying characteristics of pistachio nuts were determined experimentally as a function of temperature, relative humidity and air velocity. Six mathematical models (Page model, modified Page model, exponential model, diffusion model, two term exponential model and Thompson model) for describing the thin-layer drying behavior of pistachio nuts were investigated. Tests were conducted using four air temperatures (25, 40, 55 and 70 °C), three air velocities (0.5, 1.0 and 1.5 m/s) and two levels of relative humidity (5% and 20%) and three replications for each treatment. Out of the six models considered, Page model was found to be the most suitable for describing the drying behavior of the pistachio nuts. The drying air temperature had the greatest effect and air velocity and relative humidity had a small effect on the drying kinetics of pistachio nuts. Effective diffusivity of water varied from 5.42×10^{-11} to 9.29×10^{-10} m²/s over the temperature range studied, with an energy activation of 30.79 KJ/mol. The temperature dependence of the diffusivity coefficients was described satisfactorily by a simple Arrhenius-type relationship.

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1. Introduction

There are about 11 species of pistachio trees (*Pistacia* spp. L.). *Pistacia vera* is the only species is grown commercially because it produces fruit of adequate size to be marketed. Species such as *P. atlantica*, *P. terebinthus* and *P. integrima* are used as rootstocks for *P. vera*. The pistachio's origin is still uncertain, but most experts agree that it probably originated in Central Asia. Domestication occurred less than 2000 years ago and traders introduced them throughout the Middle East and Mediterranean area. Most pistachio production occurs in countries with warm arid climate. Iran, United States, Turkey, Italy and Syria

are the principal pistachio production countries. Pistachio nuts are grown mainly for export in these countries. Trees are also grown in Pakistan, Greece, India and Australia. Due to high nutritional value and favorable taste, planting pistachio trees has become common in other parts of world. Iran is the world's largest pistachio producer and exporter. It has produced more than 250 000 tonnes in 2003 and exported 115 335 tonnes to different countries in 2002 (FAO, 2003). Pistachios are served principally as salted nuts. A large percentage of pistachios are marketed in the shell for snack food. Non-split, filled nuts are used for processing. The food industry uses pistachios for cakes, biscuits, pies, candies, ice cream and pistachio butter. It is also used as the main ingredient of many Iranian desserts. They are also used as stuffing for both meat and snacks. Pistachio nuts contain 25% protein (mainly essential amino acids), 16% carbohydrate (mainly sucrose) and 55% oil (80% unsaturated fatty acids). Pistachios are also

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