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FULL LENGTH ARTICLE

# Effect of storage duration on some physical properties of date palm (cv. Stamaran)

**Eisa Hazbavi** [a], **Mohammad Hadi Khoshtaghaza** [a,*], **Ahmad Mostaan** [b], **Ahmad Banakar** [a]

[a] *Department of Agricultural Machinery Engineering, Tarbiat Modares University, P.O. Box 14115-139, Tehran, Iran*
[b] *Date Palm and Tropical Fruits Research Institute, Ahwaz, Iran*

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**Abstract** Most of the date fruits are processed traditionally in Iran. It becomes imperative to characterize the fruits with a view of understanding the properties that may affect the design of machines to handle their processing. The objectives of this study were to find the basic physical properties of date fruit at different storage time. Some physical properties of the Iranian Stamaran date variety were measured at the tamr stage of maturity for pitted dates during 6 months storage (25 °C of temperature and 75% of humidity). The results showed that length of the samples decreased by 8.31% from 39.21 to 35.95 mm, and no significant change for width and thickness. Mean mass and volume of the fruit did not change significantly. The projected area along length ($P_L$) did not change significantly, but projected areas along width ($P_W$) and along thickness ($P_T$) decreased by 4.26% from 647.41 to 619.8, and 8.32% from 666.89 to 611.43 mm$^2$, respectively. The fruit density, bulk density, porosity and sphericity did not change significantly. The geometric mean diameter and surface area decreased by 5.01%, from 25.53 to 24.25 mm, and 9.57%, from 2049.3 to 1853.1 mm$^2$, respectively. The mean coefficients of static friction increased significantly from 0.36 to 0.38, 0.33 to 0.35 and 0.42 to 0.45 on steel, galvanized iron, and plywood, respectively.



## 1. Introduction

Good harvest, handling and storage practices of agricultural materials and proper processing and converting these materials into food and feed products, require a deep understanding of their physical properties. Size and shape are most often used to describe agricultural materials. Shape and physical dimensions are important in sorting and sizing of fruits, and determining how many fruits can be placed in shipping containers or plastic bags of a given size. Quality differences in fruits,

* Corresponding author. Tel.: +98 2148292310; fax: +98 2148292200.
E-mail address: khoshtag@modares.ac.ir (M.H. Khoshtaghaza).

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vegetables, grains and seeds can often be detected from variations of their densities. When fruits and vegetables are transported hydraulically, the design fluid velocities are related to both density and shape. Volumes and surface areas of solids must be known for accurate modeling of heat and mass transfer during cooling and drying. Porosity, which is the percentage of air space in particulate solids, affects the resistance to air flow through bulk solids. Airflow resistance, in turn, affects the performance of systems designed for forced convection drying of bulk solids and aeration systems used to control the temperature of stored bulk solids. Knowledge of frictional properties is needed for design of handling equipment (Stroshine, 1998).

Many researchers have conducted experiments to find the physical properties of various fruits and crops. Owolarafe and Shotonde (2004) determined some physical properties for okra fruit at a moisture content of 11.42% (wet basis). Akar and Aydin (2005) evaluated some physical properties of gumbo fruit varieties as functions of moisture content. Kashaninejad et al. (2006) determined some physical and aerodynamic properties of pistachio nut and its kernel as a function of moisture content in order to design processing equipment and facilities. Topuz et al. (2005) determined and compared several properties of four orange varieties. Also, Keramat Jahromi et al. (2008) obtained some physical properties of date (cv. Dairi). Tigist et al. (2012) found the effect of variety on yield, physical properties and storability of tomato under ambient conditions. Results showed that fruit weight and volume decreased significantly during 32 days storage. Al-Mughrabi et al. (1995) researched on the effect of storage duration on fruit quality of pomegranate and results showed that weight loss gradually increased with time in storage and the physical properties of the fruits were affected by the storage treatments. Corrales and Canche (2008) have studied the effect of low-temperature-storage on physical and physiological of pitahaya fruit changes. Results showed that pitahaya sensitivity to low temperatures was manifested in undesirable appearance of the fruit due to slight browning, loss of firmness, and increase in the production of ethanol and acetaldehyde in the pulp, as well as to the scarce development of pinkish-red coloring in the peel and increased respiration rate of the fruit.

Determination of physical properties of date palm at storage duration is necessary to develop optimal process technology of storage material. The objectives of this study were to determine physical property variations of date (cv. Stamaran) during the storage and to determine the role of storage period on various fruit physical property models.

## 2. Materials and methods

In this study, Stamaran cultivar date fruit samples (Fig. 1) were selected randomly from a local market in Ahwaz (an important city in date production located in the south of Iran). The fruits were placed into a clear PET pack and stored in a room conventional store (25 °C of temperature and 75% of humidity). Physical properties of the samples were measured after 0.5, 1, 3, and 6 months of storage.

In order to measure moisture content, the samples were dried in an oven at 105 °C. The weight loss on drying to a final constant weight was recorded as the moisture content (AOAC, 2005). Mass of individual fruit was determined using an electronic balance with an accuracy of 0.001 g.

**Figure 1** Packed date samples (cv. Stamaran).

Fruit unit volume was measured by water displacement method. The fruit is forced into the water by means of a sinker rod or thread then reading of the scale with the fruit submerged minus the weight of the container and water is the weight of the displaced water which will be used in Eq. (1) to calculate volume (Fig. 2). Finally, fruit densities ($\rho_f$) were calculated by dividing unit mass to the unit volume (Mohsenin, 1986):

$$\text{Fruit unit volume (cm}^3) = \frac{\text{Weight of displaced water (g)}}{\text{Density of water (g cm}^{-3})} \quad (1)$$

where, density of water = 1 g cm$^{-3}$

Bulk density ($\rho_b$) was determined using the mass/volume relationship by filling an empty plastic container of predetermined volume and mass with fruits that were poured from a constant height, and weighed. Porosity ($\varepsilon$) was then calculated using Eq. (2), as the ratio of the differences in the fruit and bulk densities to the fruit density (Owolarafe et al., 2007):

$$\varepsilon = \left(\frac{\rho_f - \rho_b}{\rho_f}\right) \times 100 \quad (2)$$

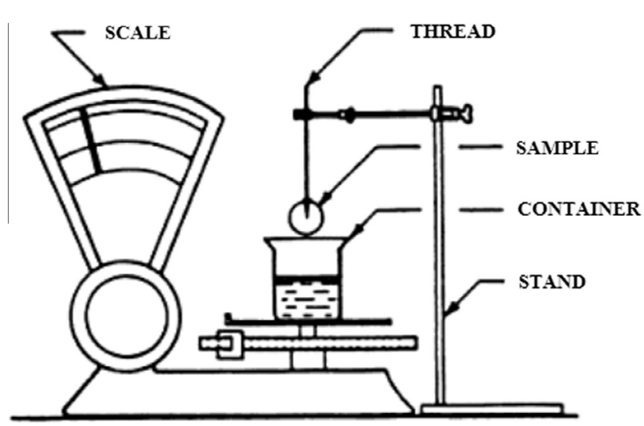


**Figure 2** Platform scale for measurement of volume (Mohsenin, 1986).