

## The Effect of Different Non-mechanical Treatments on Splitting Pistachio Nuts

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### Abstract

One of the undesirable features in pistachio nuts (*Pistacia vera* L.) is the incidence of non-split nuts, which affects the price of the final product. In order to attain the kernel inside, the non-split nuts are mostly cracked mechanically. However, this practice may damage the kernel. Akbari variety of pistachio nut was selected to evaluate the influence of different non-mechanical treatments on splitting the nuts. Different treatments were applied by soaking the nuts in water at different temperatures (10, 100 °C) and roasting and heating by oven and microwave in different orders. The results indicated that soaking along with thermal treatment had a significant effect on the amount of splitting ( $P < 0.05$ ), while no significant effect was observed in the methods in which the samples were not soaked. Furthermore, the temperature of the water applied for soaking and also thermal treatment medium led to significant differences in the final results. Additionally, the order of application of different treatments were analyzed and proved to be significantly effective ( $P < 0.05$ ) on the splitting percentage of the nuts.

**Keywords:** Microwave, Non-mechanical methods, Pistachio, Splitting,

### Introduction

Pistachio nut (*Pistacia vera* L.) is one of the popular tree nuts. Several species of the genus *Pistacia* are referred to as pistachio, but only the fruits of *P. vera* attain a large enough size to be acceptable to consumers as edible nuts (Shokraii and Esen 1988).

Pistachio nut is grown mainly in Iran, USA, Syria, Turkey, Greece and Italy (Kucukoner and Yurt 2003). Based on FAO statistics (FAO 2009), with the production of 446,647 Mt pistachio nuts in 2009, Iran is the biggest producer of this commodity all around the world. Pistachio kernels are a good source of fat (50–60%) and contain unsaturated fatty acids (linoleic, linolenic and oleic acids), essential for human diet (Garcia et al. 1992; Shokraii 1977).

The pistachio shell splits as the nut matures, a desirable feature for marketing and consumption. Split means more than 3/4 of a half kernel split lengthwise (United States department of agriculture 2004). However, the hull remains intact in the majority of mature pistachios at harvest (Sommer et al. 1976). The hull protects the kernel from invasion by molds and insects as nuts that are poorly protected by hulls are most prone to contamination in the orchard.

To delay the harvest in order to have more split nuts results in excessive hull tissue breakdown, which causes shell staining and increased insect damage and *Aflatoxin* contamination (Doster and Michailides 1995). Zeng et al. (1999) showed that the potassium sulfate ( $K_2SO_4$ ) treated trees produced significantly higher percentages of split nuts, higher 100-nut weight, and a significant lower percentage of blank and stained nuts than in the control trees not receiving K ions. This clearly demonstrates improved nut quality due to K fertilization. The unsplit nuts are usually used as raw material in wafer, ice cream,

pistachio butter, pistachio oil, etc. production. The percentage of split, blank, and stained nuts and 100-nut weight are the major quality criteria used to grade pistachio nuts. It is desirable to produce a high percentage of split nuts and a high 100-nut weight, but low percentages of blank and stained nuts (Zeng et al. 1999). When pistachios arrive at the processing plant, the split nuts separation is conducted to separate split nuts from unsplit ones (Kashaninejad et al. 2003). Empty or partially empty pistachios are separated by an air stream and unsplit pistachios by floatation in water and split mechanically, which results in cracking the kernel and according to a study achieved by Ahmadi and Tajabadipour (2011) increases the risk of nuts contamination with *Aflatoxin*. On the other hand the unsplit nuts contain kernels of a desirable deep green color, which are of interest for confectionaries (Woodroof 1979). Therefore, opening the nuts in a way that the kernels are not cracked is quite desirable.

Microwave is an electromagnetic wave in the frequency range of 300–30,000 MHz which its fields interact with the non-magnetic materials. The conversion of microwave energy into heat in the food is because of the presence of bipolar molecules of water that rotate in the changing electromagnetic field (billion times a second), heat is generated within the food product due to friction between the water molecules. The quick absorption of energy by water molecules leads to fast evaporation of water that causes an outward flux of fast escaping vapor (Schiffmann 1992) which was hoped to favor pistachio nut splitting in this study. Kouchakzadeh and Shafeei (2010) have already applied microwave for drying pistachio nuts but its application in splitting the nuts has not been reported.

Literature review demonstrated that there is not enough work in this field except for a study by Bilim

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### Abbreviations

ANOVA	Analysis of variance
FAO	Food and Agriculture Organization
$K_2SO_4$	Potassium sulfate
K	Potassium
MHz	Megahertz
SAS	Statistical Analysis System