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Resistance of bulk pistachio nuts (Ohadi variety) to airflow

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ABSTRACT

The resistance to airflow of bulk pistachio nuts (Ohadi variety) was determined using a laboratory unit in the range of 4.08–38.40% (w.b.) of moisture content, 0.08–1.00 $m^3/s\ m^2$ airflow rate, 0–100 cm of bed depth and two fill methods. Three models (Shedd, Hukill and Ives, and Ergun equations) were investigated to describe pressure drop data of pistachio nuts. The pressure drop through the bulk pistachio nuts increased with an increase in airflow rate, bed depth, moisture content and bulk density. An increase in the moisture content range of 4.08–38.40% (w.b.) resulted in about 55% increase in pressure drop. The dense fill caused an increase in pressure drop by about 97% than that of loose fill. Shedd model was found to be the best equation to describe airflow resistance of pistachio nuts.

1. Introduction

Pistachio nut (*Pistacia vera* L.) is one of the popular tree nuts in the world. Due to its high nutritional value and split shell, pistachio is an increasingly important nut crop consumed raw, roasted or salted. The kernels are a good source of fat (50–60%) and contain unsaturated fatty acids essential for human diet (Shokraii, 1977). It is used in confectionery, snack foods, ice cream and pastry industries (Woodroof, 1979). Proper postharvest processing especially drying and storage are key operation in achieving maximum yield of good quality nuts (Kader et al., 1982). Proper aeration during drying and storage can provide uniform airflow distribution in bulk pistachio nuts and avoid mold growth.

Air is used in drying, aeration and storage systems of biological materials. In drying, air carries heat to and moisture from the product, while in aeration, air cools the product by carrying away the heat. Moisture removal or cooling, in these cases, cannot be achieved if air is not forced through the material. When air is forced through a layer of bulk agricultural materials, resistance to the flow, the so-called pressure drop, develops as a result of energy lost through friction and turbulence (Brooker et al., 1992; Hall, 1980). The prediction of airflow resistance, which is fundamental to the design of efficient drying and aeration systems, has been studied for the past 70 years. Fan selection for drying and aeration systems requires knowledge of how much airflow resistance will be developed in a particular bed of grain (Yang and Williams, 1990; Jayas et al., 1991). Drying, areation and storage are key stages in pistachio nuts production. In pistachio nut dryers, forced air is necessary to provide the heat of vaporization of moisture and remove the moisture from the nuts. In storage bins, aeration is necessary to maintain the previously dried pistachio nuts at uniform and sufficiently low temperature to avoid mold growth, aflatoxin production and undesirable chemical reactions such as rancidity. Since the first infection with molds takes place already in the pistachio orchard, the most important preventive method after harvesting is to prevent further growth of the molds and toxin production. Thus, pistachio nut should be dried properly and uniformly as soon as possible after harvesting and stored in an appropriate condition. To optimally design the forced ventillation systems for drying and cooling the stored bulk, the resistance to airflow through bulk pistachio nut is an essential parameter and must be estimated to a reasonable accuracy. The design of efficient systems for drying and aeration of nuts can only be achieved with information on airflow resistance of the nuts. The pressure drop through a bed of nut depends on the airflow rate, bed depth, moisture content, fill method, and surface and shape characteristics of the nut (Gunasekaran and Jackson, 1988).

Airflow resistance through bulk of major crops such as lentils (Sokhansanj et al., 1990), flax seed (Jayas et al., 1991), potato (Irvine et al., 1993), alfalfa seed, cubes and pellets (Li and Sokhansanj, 1994), garlic slices (Madamba et al., 1994), sesame seed (Dairo and Ajibola, 1994), wheat (Giner and Denisienia, 1996), sugar beet (Tabil and White, 1999), sorghum and rough rice (Chung et al., 2001), paddy and its byproducts (Nalladurai et al., 2002) and pelleted feed (Ray et al., 2004) have been reported in

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