Pistachio Storage Conditions: Quality Changes, Causes, and Protection Methods

Roya Peirovi-Minaee (PhD)

Department of Environmental Health Engineering, Faculty of Public Health, Social Determinants of Health Research Center, Gonabad University of Medical Sciences, Gonabad, Iran

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Abstract

The economic status of pistachios, apart from their nutritional value, has attracted the attention of researchers. Pistachio storage conditions, being the subject of the current research, have been studied by researchers. Pistachios are usually stored for a short or long period of time before distributed to the market. Therefore, suitable storage conditions are essential for pistachio health and quality. Accordingly, employing novel storage methods can lead to more nutritional benefits in fresh pistachios.

Keywords: Pistachio Health, Pistachio Storage, Quality Change

1. Introduction

Pistachios are a product with a unique economic share in the country's exports. Iran's pistachio production ranked first in the world in 2005, while for various reasons, including water shortage and low precipitation, it experienced a drop and ranked second in 2018. Pistachios contain many nutrients that vary during different fruit ripening stages. Due to the characteristics of pistachios and lack of suitable storage methods, they are mainly consumed dry; however, consumption of fresh pistachios is limited to the harvest season and to cities surrounding pistachio cultivars [1- 4]. Pistachios are usually stored for a short or long period of time before distributed to the market. Extending the shelf life of pistachios depends not only on storage conditions and the type of packaging but also on pre-harvest conditions, such as the irrigation rate, nutrition, ambient temperature, pests, harvest time, and processing speed [5]. Therefore, suitable storage conditions are effective in improving pistachio health and quality. Accordingly, it is necessary to improve the shelf life of fresh pistachios by employing different methods and maintaining quality attributes of marketability during the storage period. This article aims to review relevant literature to summarize quality changes of pistachios so as to prevent such changes in the storage period.

2. Results and Discussion

2.1- Pistachio qualitative changes in storage and causes

2.1.1-Solutions for maintaining quality of pistachios

Various parameters, including temperature, relative humidity, chemical composition, spoilage microorganisms, and natural enzymes affect the shelf life of pistachios [1]. Having brittle and soft shells as well as a high respiration rate are the main reasons for the short shelf life of fresh pistachios. Thus, apart from appropriate and timely harvesting, there should be postharvest processing methods for reducing the respiration rate of fresh pistachios. These considerations can result in reducing the water content, maintaining pistachio appearance, and gaining customer acceptance. Controlling the respiration process in harvested crops can reduce metabolic processes, thereby increasing the postharvest shelf life [6].

Relative humidity of pistachios is consistent with that of the storage environment. If humidity is too high, pistachios absorb it, with growth conditions for aflatoxin-producing fungi being improved [2]. Changes in appearance, sensory properties, kernel tissues, and overall acceptability occur in storage. Other changes include oxidation of oils by decomposition of fatty acids with double bonds and production of free

radicals, which lead to a reduction in the natural antioxidants, nutritional value, and sensory properties of oils [7, 8].

2.1.2- Solutions for maintaining quality attributes of pistachios

To control oxidation reactions in storage, various solutions have been presented. These solutions include a reduction in the oxygen concentrations, controlled atmosphere storage, modified atmosphere packaging, and monolayer moisture content.

Various studies have been conducted on different storage methods of fresh and dry pistachio nuts. These studies include kinetic investigation of pistachio fat oxidation reactions [1], evaluation of oxidation resistance and storage forecast of pistachio oil [7], freezing [2], freezing and vacuum packaging [8], microwave drying by the IMD method [9], examination of storage conditions [10], and investigation of different packaging conditions and materials [11, 12]. Findings of these studies show that the storage duration at 25°C is 386, 786, and 280 days for wild pistachio skin oil, wild pistachio kernel oil, and Ahmad Aghaei variety. Regarding commercial types of pistachios, the Ahmad Aghaei variety showed 1.5 times longer a storage duration than other varieties [7]. Research shows that factors, such as an increase in the shelf life, temperature, and packaging weight significantly enhance the weight loss, acidity, peroxide value, and aflatoxin contamination [5]. In addition, the peroxide value, acidity value, and free fatty acids were reported to be less in frozen pistachios in vacuum containers than in vacuum-packed samples at room temperature. In a study, data on sensory evaluations (taste, odor, color, texture, and overall acceptability) were significantly different ($P< 0.05$) between the samples [8]. Although changes in the taste and acidified water have been reported as drawbacks of the freezing method (-18°C), it has been reported to increase overall acceptability of stored pistachios depending on the harvest time [2]. According to research, pistachio kernels' best shelf life in plastic films, including LDPE, PVC, nylon, PA/PP, and PET was about 4, 4, 4, 5, and 6 months, respectively. Accordingly, PET films, nylon, PA/PP, and PVC (of a food grade) are considered the most suitable packaging materials for maintaining pistachio kernels' quality and safety [12]. Research results revealed that conventional packaging contains a higher amount of mesophilic bacteria and free fatty acids than vacuum packaging (VP) and modified atmosphere packaging (MAP). Therefore, MAP is generally recommended for maintaining quality attributes of fresh raw pistachios for a longer storage period [11]. The effect of the drying method on the shell split size was reported to be significant ($P< 0.01$). In addition, the strength and hardness index (Meyers index) of sun-dried

pistachios were reported to be lower than those dried using the IMD method. Besides, the hardness of sun-dried pistachio kernels was less than that of IMD-dried kernels. Additionally, the IMD method had no significant effect on the fat and protein content of the sample, while the acidity and peroxide values were significantly affected ($P< 0.05$) [9]. Upon foliar spraying of 1 mM putrescine, spermidine, and permine 20 days before the harvest time, hull and kernel firmness, hull and fruit water content, the L^* index of hull and shell, hue angle and chroma indices, as well as the chlorophyll content decreased during the storage period.

It is worth noting that polyamines maintained quality attributes of pistachios compared to the control treatment; in addition, the use of putricin had a more positive effect on quality attributes than spermine and spermidine. In addition, the concomitant application of 1% chitosan coating with putrescine led to further preservation of these indices [6]. According to research, factors affecting the shelf life of pistachios are the variety of pistachios, cultivation climate, the ripeness degree at the harvest time, as well as pre-planting, planting, and post-planting considerations. These factors explain the differences in the findings of some studies in this field. For higher storage efficacy, necessary measures must be adopted thoughtfully since the planting stage. Besides, to improve quality attributes of exported pistachios, an improvement in planting and care conditions should be prioritized over varieties of higher nutritional values.

3. Conclusions

Inappropriate packaging leads to a decrease in the economic value of exported pistachios. Thus, it is necessary to take necessary measures to assure proper production, processing, and packaging so as to prevent a waste increase and to improve quality attributes of exported pistachios. The use of novel methods has been proven to be efficient and cost-effective in pilot projects. Accordingly, these methods can increase benefits of fresh pistachios, reduce drying costs, raise nutritional values, and lead to tax exemptions.

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