



# Application of modified atmosphere packaging to increase shelf-life in fresh pistachio nuts

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## INTRODUCTION

Fresh-harvested pistachios have favorable attributes for the growth of spoilage or harmful microorganisms such as mycotoxigenic fungi. Moreover, noticeable undesirable defects such as shell-staining, hull-decay and off-odors are quickly developed after harvest. Thus, in practice, pistachios are dehulled and dried to <7% moisture as soon after harvest as possible to ensure safety and quality. However, there is a market demand for fresh pistachios.

## AIM OF THE STUDY

The Modified Atmosphere Packaging (MAP) technology was evaluated as a way to preserve fresh pistachios, considering the safety and maintenance of consumer-desired quality attributes such as freshness, texture, flavor and color.




## MATERIALS & METHODS

**Product:** Fresh in-hull pistachios of the Greek variety "Aegina" harvested in 2014  
**Sample size:** 15 pistachio nuts (3 replicates)  
**Packaging material:** 15x20cm HDPE bag (90µm thickness)  
**Untreated sample:** In-hull pistachios in commercial PE bags, 5°C  
**Treatment conditions:** 25 and 5°C and 55%RH (see Table 1)  
**Evaluated quality attributes:**

- Fungal isolation from the kernels (DRBC plating, incubation for 7 days)
- Weight
- Color (Minolta colorimeter)
- Firmness (Instron)
- Oxidative rancidity (peroxide value)

**Sampling intervals:** 10, 20, 47 days

Table 1. Experimental design

| TREATMENTS  |   | PISTACHIO SAMPLES   |   |   |
|-------------|---|---|---|---|
| Temperature | In-pack gas composition                           |  |  |  |
|             |   | A: in-hull  | B: in-shell   | C: kernel   |
| T1=5°C      | MAP 1 (20% CO <sub>2</sub> : 80% N <sub>2</sub> ) | ✓   | ✓   | ✓   |
|             | MAP 2 (25% CO <sub>2</sub> : 75% AIR)             | ✓   | ✓   | ✓   |
|             | VACUUM  | ✓   | ✓   | ✓   |
| T2=25°C     | MAP 1 (20% CO <sub>2</sub> : 80% N <sub>2</sub> ) | ✓   |   |   |
|             | MAP 2 (25% CO <sub>2</sub> : 75% AIR)             | ✓   |   |   |
|             | VACUUM  | ✓   |   |   |

## RESULTS

Table 2. Quality attributes ranking (+++ = acceptable, ++ = marginally acceptable, + = rejected)

| TREATMENTS  |                         | PISTACHIO SAMPLES |       |          |               |             |       |          |               |           |       |          |               |
|-------------|-------------------------|-------------------|-------|----------|---------------|-------------|-------|----------|---------------|-----------|-------|----------|---------------|
| Temperature | In-pack gas composition | A: in-hull        |       |          |               | B: in-shell |       |          |               | C: kernel |       |          |               |
|             |                         | weight            | color | firmness | fungal growth | weight      | color | firmness | fungal growth | weight    | color | firmness | fungal growth |
| T1=5°C      | MAP 1                   | +++               | ++(+) | +++      | +++           | +++         | +++   | +++      | +++           | +++       | ++(+) | +++      | +++           |
|             | MAP 2                   | ++                | +++   | +++      | +++           | +++         | ++(+) | ++(+)    | ++(+)         | +++       | +++   | +++      | +++           |
|             | VACUUM                  | ++(+)             | ++    | +(+)     | ++(+)         | +++         | ++    | ++(+)    | ++(+)         | +++       | ++    | ++       | ++(+)         |
| T2=25°C     | MAP 1                   | ++                | +(+)  | ++(+)    | ++(+)         |             |       |          |               |           |       |          |               |
|             | MAP 2                   | +                 | +(+)  | ++(+)    | +++           |             |       |          |               |           |       |          |               |
|             | VACUUM                  | +(+)              | +     | +(+)     | ++(+)         |             |       |          |               |           |       |          |               |

### Fungi identification:

- *Penicillium*
- *Cladosporium*
- *Alternaria*
- *Fusarium*
- *Aspergillus sc Nigri*
- *Aspergillus sc Flavi*



OPTIMUM RESULTS

T1 = 5°C

Untreated - 0 days



Untreated - 47 days



MAP1 - 47 days



MAP2 - 47 days



VACUUM - 47 days



## CONCLUSIONS

- Treated samples stored at 5°C resulted at acceptable sensory attributes after 47 days.
- In contrast, untreated samples at 5°C were rejected - scored (+) – after 20 days.
- All samples at vacuum had darker shell color and softer kernel, as well as an unpleasant odor after 20 days, for 5 and 25°C
- Samples in MAP1 and MAP2, at 5 and 25°C, scored higher compared to samples under vacuum after 47 days.
- In-hull pistachios stored at 5°C scored higher than the samples stored at 25°C for all quality attributes.
- In-hull pistachios in MAP1 scored higher than the MAP2-samples for all quality attributes except shell color.
- Weight loss was greater for the in-hull samples, however, it was significantly less in the samples stored under both modified atmospheres than the respective untreated pistachios.
- Fungal growth was significantly limited for all samples stored under modified atmospheres compared with the untreated samples.
- None of the samples showed oxidative rancidity.