Chemical Markers Measuring Quality of Moisture Exposed Almonds

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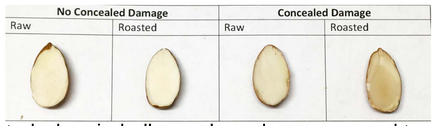
ABSTRACT

Almond quality is affected by moisture and temperature exposure post-harvest. Moisture exposure > 6% can result in a quality defect termed concealed damage (CD), which is a brown discoloration of the nutmeat after moderate to high heat treatments (roasting, blenching, etc.). Current industrial practice for reducing moisture in almonds prior to processing, is to apply low heat to in-hull almonds until a moisture content of ~6% is achieved. Drying is used to reduce the visual discoloration of the nutmeat however the quality storage lifetime of these almonds is unknown. To address this, almonds exposed to moisture (ME, ≥ 8%), and subsequently dried to ≤ 6% moisture, were roasted to give either light roast or dark roast almonds. Raw and roasted almonds were held under accelerated shelf-life conditions that promote rancidity development and evaluated over 12 months. Peroxide value (PV), free fatty acid value (FFA), conjugated dienes (CD), and headspace volatiles, were evaluated. Results demonstrate that there is a significant difference between the ME almond and non-ME almond over time. A significant difference was observed between light roast and dark roast almonds with storage. Additionally, differences between the quality of ME and non-ME almonds were observed over accelerated shelf-life.

INTRODUCTION

Concealed Damage

- Brown discoloration of the almond nutmeat shown after heat treatment.



- Initiated when in-hull raw almonds are exposed to a warm and moist environment post-harvest and the kernel moisture reaches ≥ 8%.
- Current industry practice with “wet” in-hull almonds is to apply low heat drying (40-50℃) until kernel moisture reaches ≤ 6%.

Moisture Exposed Almonds: Almond kernel that experienced a rise in **moisture content to 8%** post-harvest and **subsequently dried** at 50 ℃ to a final **moisture content of 5%**.

- Suspect to present quality defects in almonds, such as lipid oxidation that leads to rancidity.

Oxidation and Rancidity

- Almonds are susceptible to lipid oxidation due to a high percentage of unsaturated fatty acids among the total lipid content.
- Lipid oxidation can be initiated and accelerated by heat, oxygen, UV radiation exposure, and moisture present during roasting and storage.
- Lipid oxidation leads to rancidity; resulting in loss of the roasted aroma/flavor and an increase of unpleasant “rancid” aroma/flavor.
- Lipid oxidation can also lead to increase level of undesired reactive aldehydes and a loss of native nutritional compounds such as unsaturated fatty acids and antioxidants.

OBJECTIVES

- To determine the quality of moisture exposed almonds during accelerated shelf-life storage using chemical markers.
- To compare the quality of almonds that have experienced moisture exposure and almonds that have not.

METHODS

Standardized Methods for Oxidation Analysis

Standardized simple methods to detect a number of lipid oxidation precursors and products have been widely used in the food industry as part of quality assurance. These tests include:

- **Free fatty acids (FFA)**
  - Hydrolytic rancidity
  - < 1.5% FFA
- **Conjugated dienes**
  - Absorbance at 233nm
  - No common standard
- **Peroxide value (PV)**
  - Early stage of oxidation
  - < 5.0 meq/kg PV

Figure 1. FFA titration

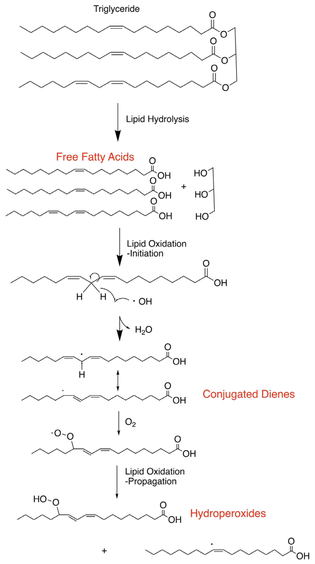
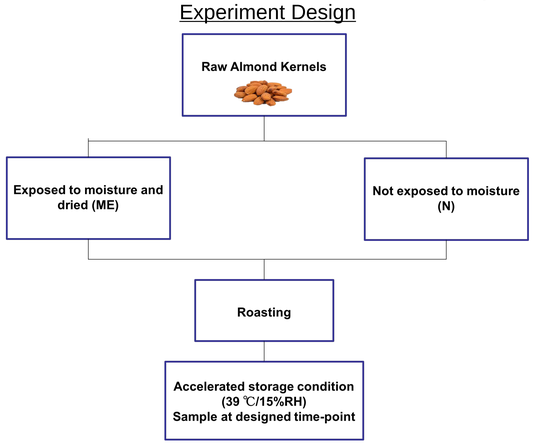


Figure 2. General lipid oxidation pathway associated with oxidation analysis

Experiment Design



- Accelerated storage for 12 months, sampled once a month
- Almond oil was pressed from the samples for oxidation analysis
- Almonds were ground and subjected to headspace volatile profiling

RESULTS and DISCUSSIONS

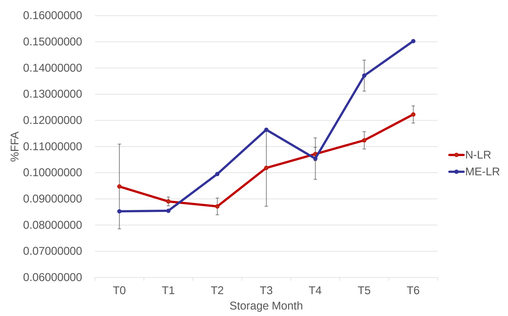


Figure 3. Free fatty acid value of moisture exposed (ME) and non-moisture exposed (N) almonds under 6 months accelerated storage condition.

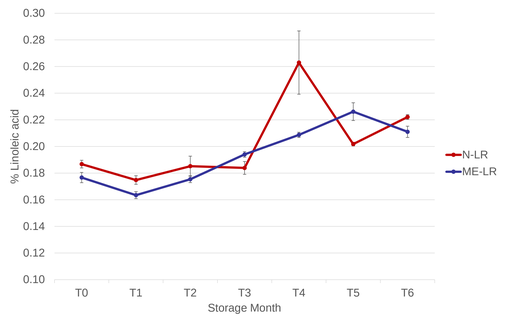


Figure 4. Conjugated diene concentration of moisture exposed (ME) and non-moisture exposed (N) almonds under 6 months accelerated storage condition.

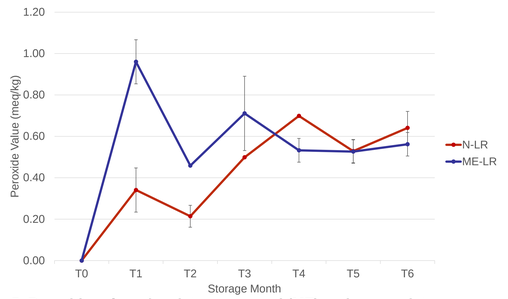


Figure 5. Peroxide value of moisture exposed (ME) and non-moisture exposed (N) almonds with light roast treatment (LR) under 6 months accelerated storage condition.

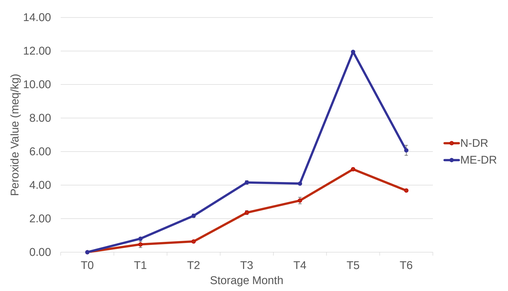


Figure 6. Peroxide value of moisture exposed (ME) and non-moisture exposed (N) almonds with dark roast treatment (DR) under 6 months accelerated storage condition.

RESULTS and DISCUSSIONS (cont.)

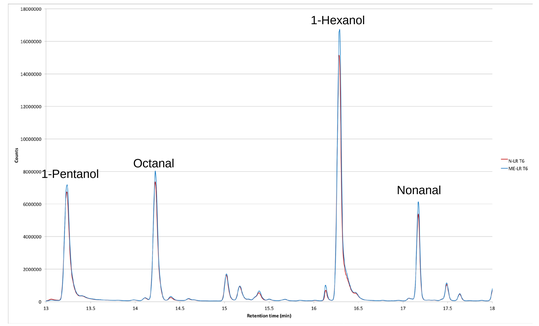


Figure 7. Total ion chromatogram from headspace SPME GC/MS overlaying ME and N almonds at 6 month accelerated storage. ME almonds indicate higher level of identified compounds which are associated with lipid oxidation and rancidity.

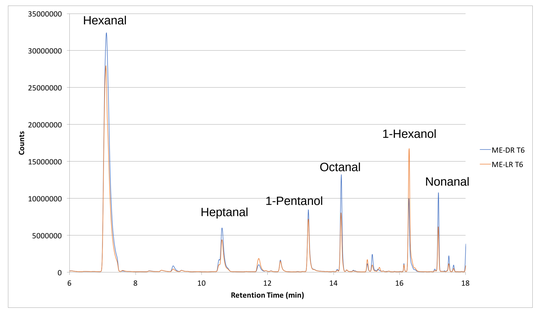


Figure 8. Total ion chromatogram from headspace SPME GC/MS overlaying ME dark roast (DR) and light roast (LR) almonds at 6 month accelerated storage. DR almonds indicate higher level of identified compounds which are associated with lipid oxidation and rancidity.

CONCLUSIONS

- Overall, our results demonstrated that moisture exposed almonds experience increase level of lipid oxidation under accelerated storage condition.
- The darker the roasting (browning) level, the higher level of lipid oxidation can be observed for both ME and N almonds. Also, increased level of lipid oxidation products can be observed in ME that has darker roasting level under accelerated storage.
- Hence, moisture exposed almonds should avoid being treated with dark roasting to extend the shelf life compared to light roasted treatment.

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ACKNOWLEDGEMENTS

The authors would like to thank Guangwei Huang from the Almond Board of California and Brian Dunning from the Blue Diamond Growers for their support and providing the almonds.