



# Almond Roasting

Roasting Process

Flavor and Sensory Properties

Roasting Optimization

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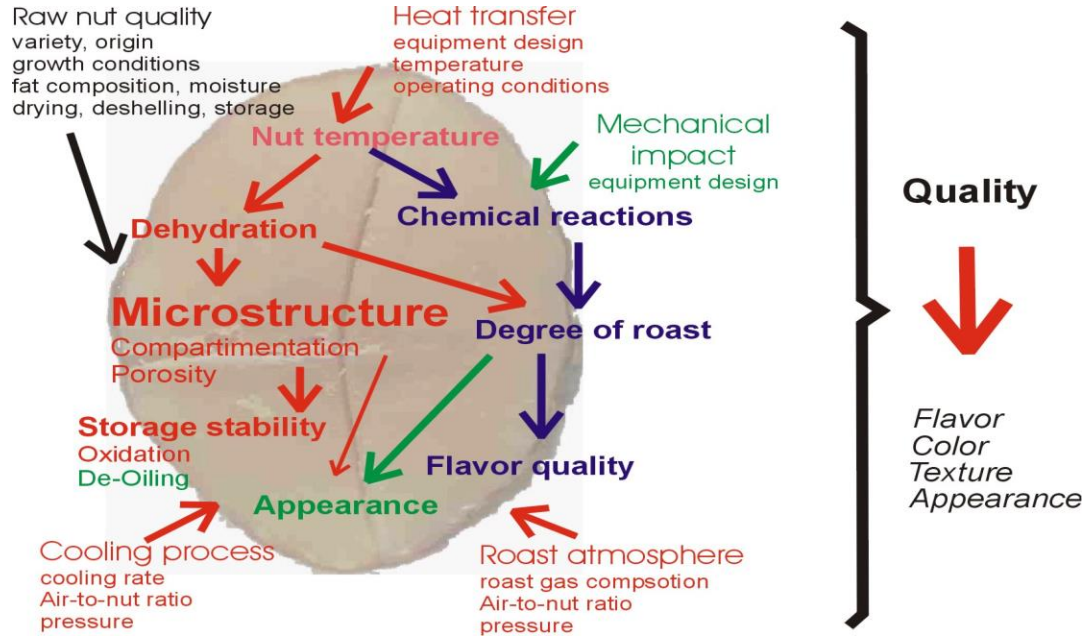




# Roasting Process



# Roasting of Almonds



## Objectives:

- Dehydration
- Develop desired flavor, texture, color

## Impact Factors:

- Quality of infeed
- Roasting parameters
- Roasting equipment
- Heating means, distribution, speed
- Cooling timing and speed

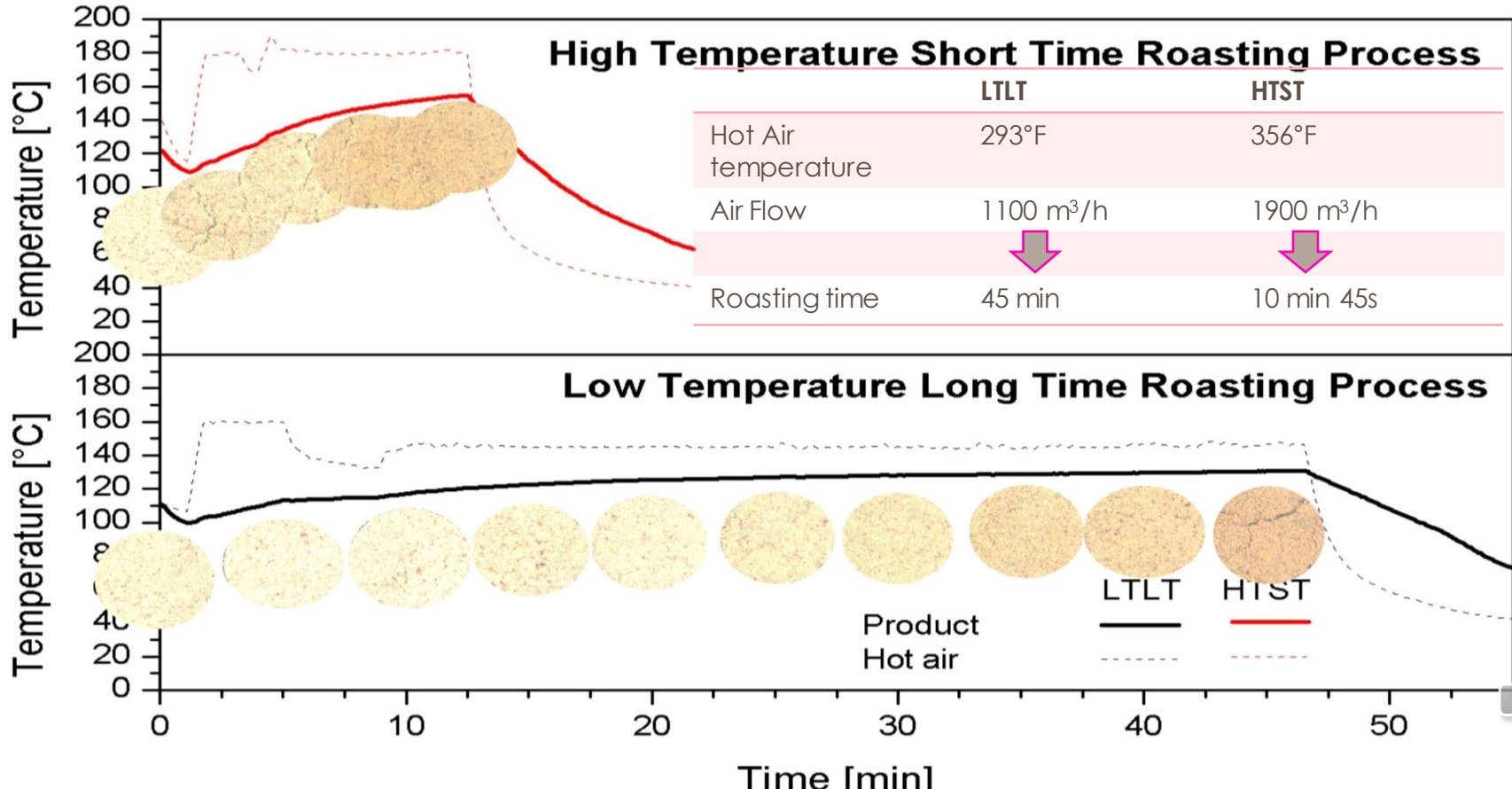
# Roasting Methods and Processes

- Degree of Roasting: light, medium, dark
- Methods: hot air or dry roast, toast, oil roast
- Oil roasting is faster than dry roast, quicker to achieve roasting color
- Dry roasted almonds are commonly used in confection
- Many combination of temperature and time can achieve roasting objective. The higher the temperature, the shorter the time. At the same temperature, the roasting time varies with in-feed load, degree of roasting, input moisture level, etc.





# High Temp Fast Roasting vs. Low Temp Slow Roasting



A close-up photograph of a glass jar filled with roasted almonds. To the left of the jar is a small, shallow glass dish containing a golden-brown liquid, likely almond oil. The background is a warm, golden-yellow color.

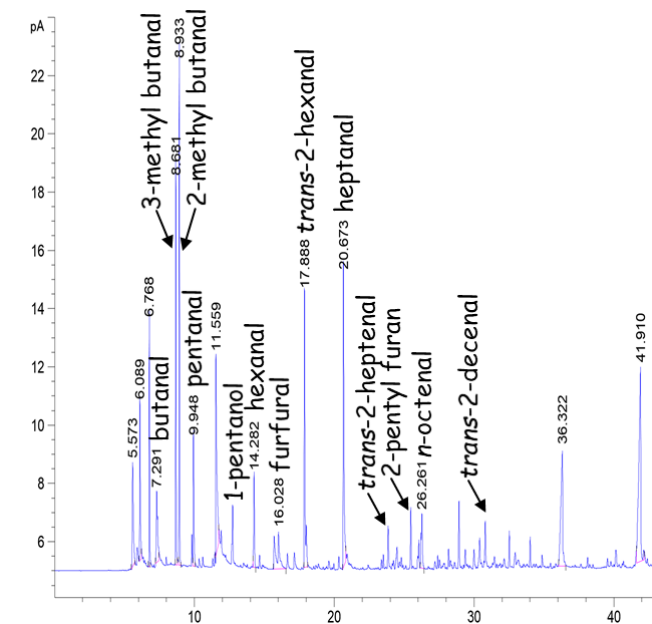
# Flavor and Sensory Properties of Roasted Almonds

# Major Flavor Volatiles Identified in Roasted Almonds

- Quantified volatiles in roasted almonds (91): 13 pyrazines, 3 low mw aldehydes, 15 high mw aldehydes, 8 low mw alcohols, 8 high mw alcohols, 2 esters, 5 low mw ketones, 6 high mw ketones, 8 organic acids, 2 alkanes, 3 alkylfurans, 5 heterocycles, 5 lactones, 5 sulfur-containing, 3 terpenes

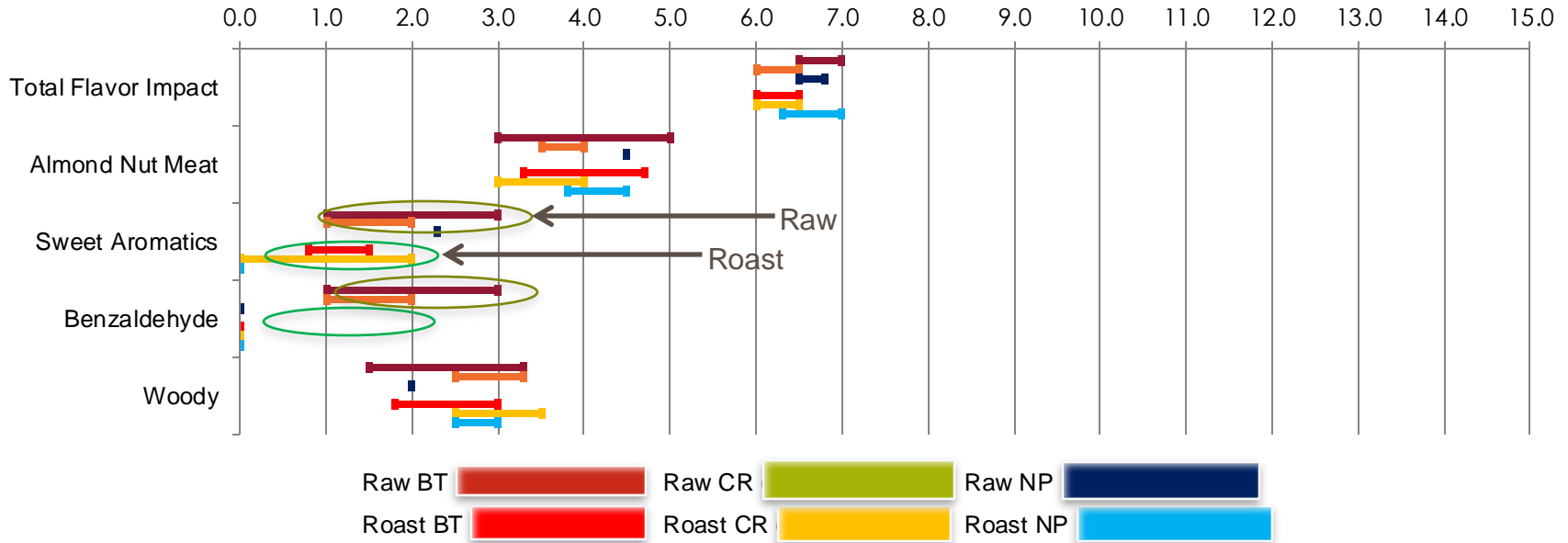
## Major Volatiles in Roasted Almonds

Compound (91)	Aroma
2 & 3-Methylbutanal	Fruity, chocolate, nutty, malty
2,5-dimethylpyrazine	Coffee, roasted nuts, cocoa
2-Methylpyrazine	Chocolate, roasty, nutty
Acetoin	Sweet, buttery, creamy
Hexanal	grassy, fatty, rancid



# Impact of Roasting on Almond Flavor

## Impact of Roasting on Almond Flavor

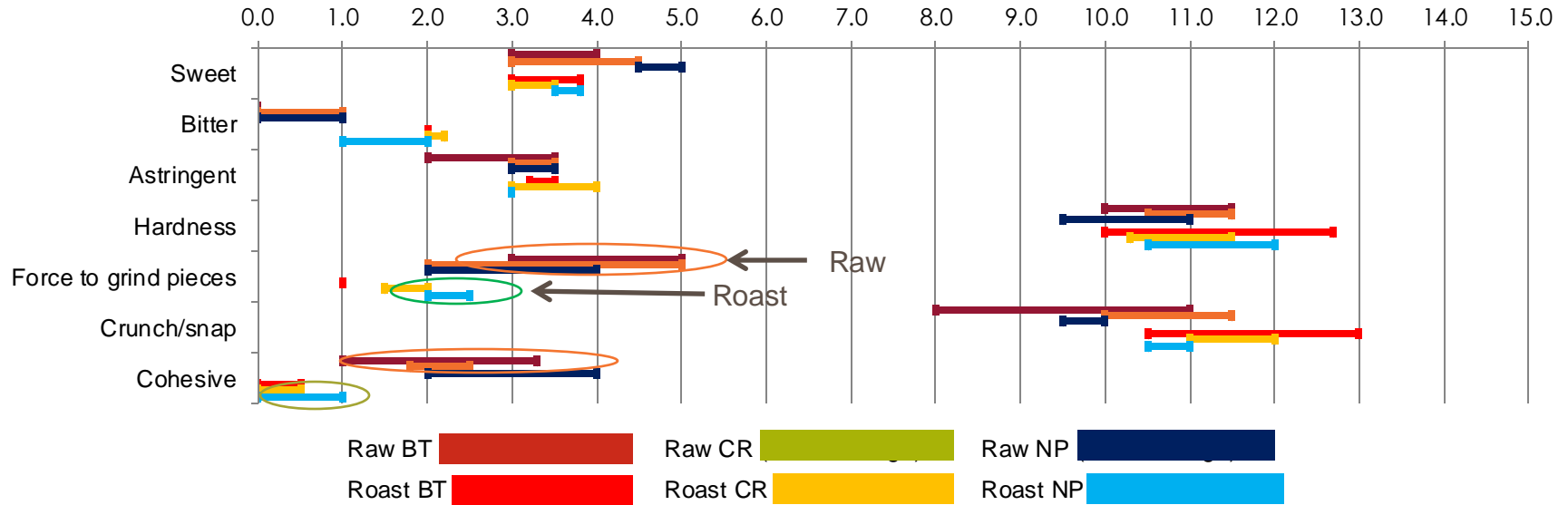


BT=Butte, CR=Carmel, NP=Nonpareil



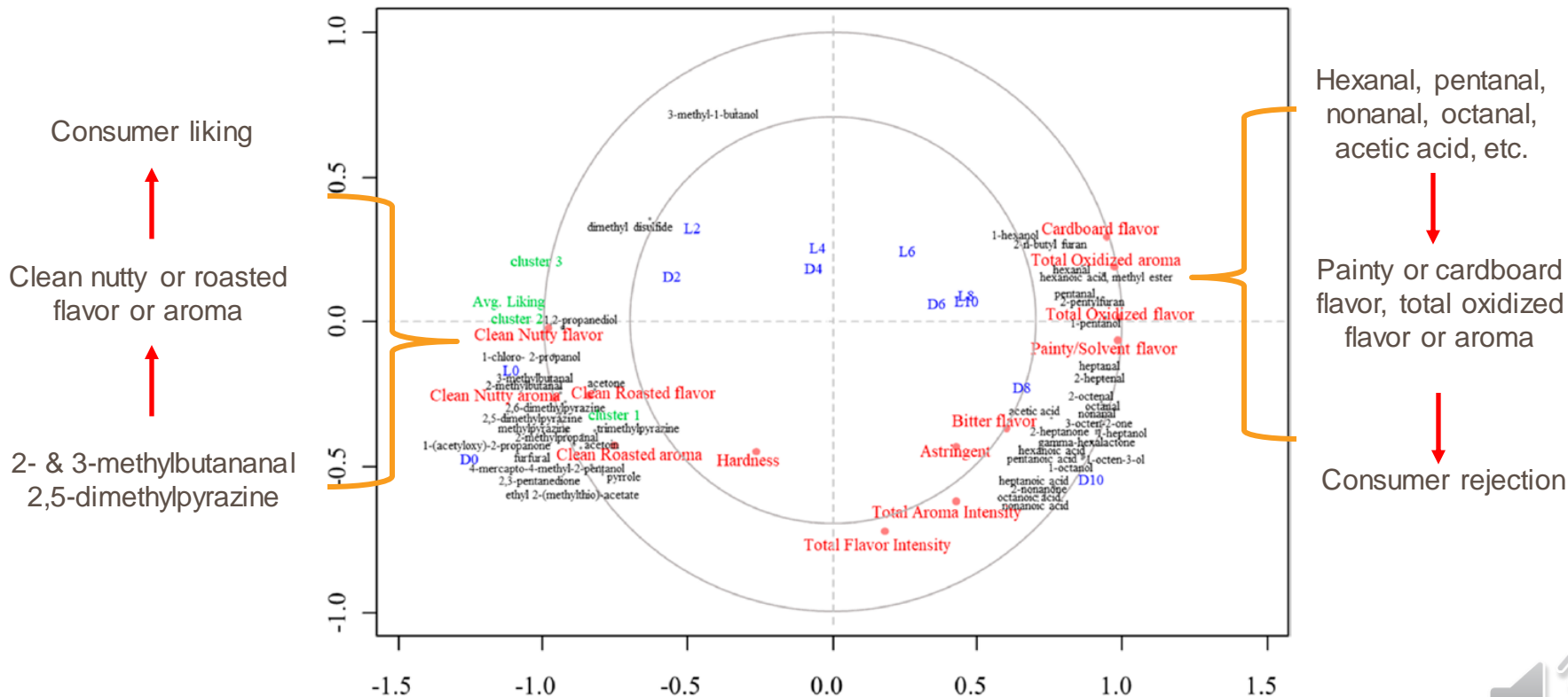
# Impact of Roasting on Almond Basic Tastes and Texture

## Impact of Roasting on Almond Basic Tastes and Texture



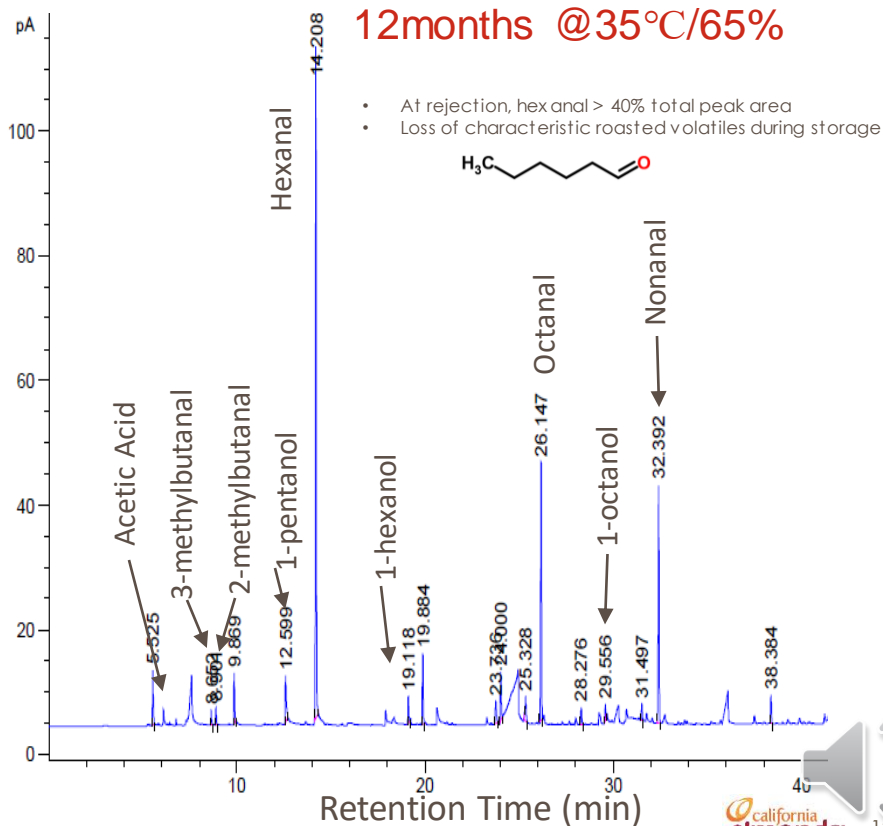
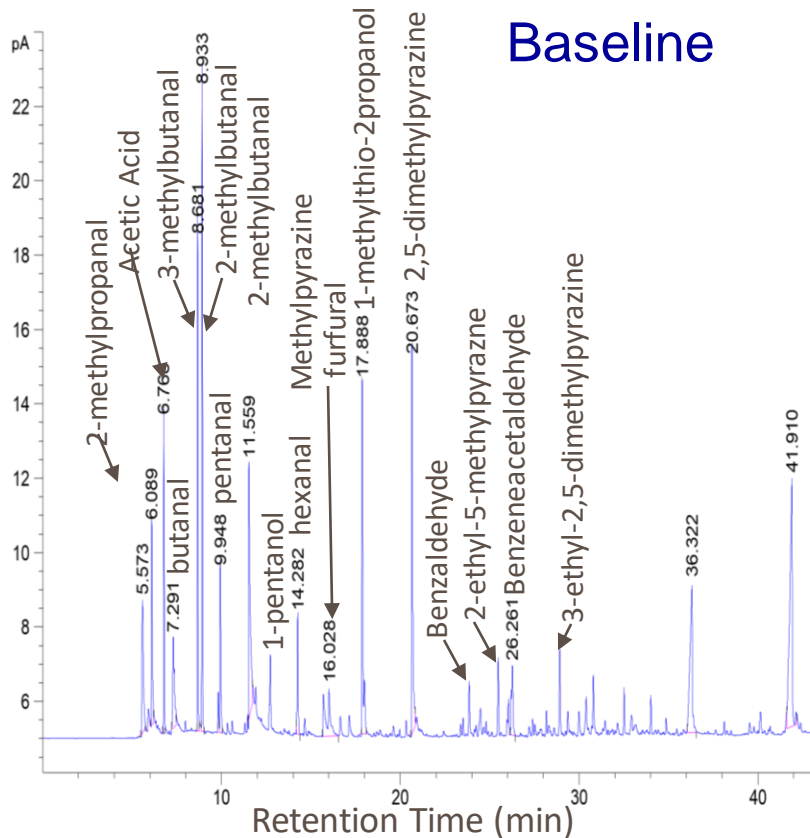
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# Sensory Profiles and Key Chemical Compounds of Roasted Almonds

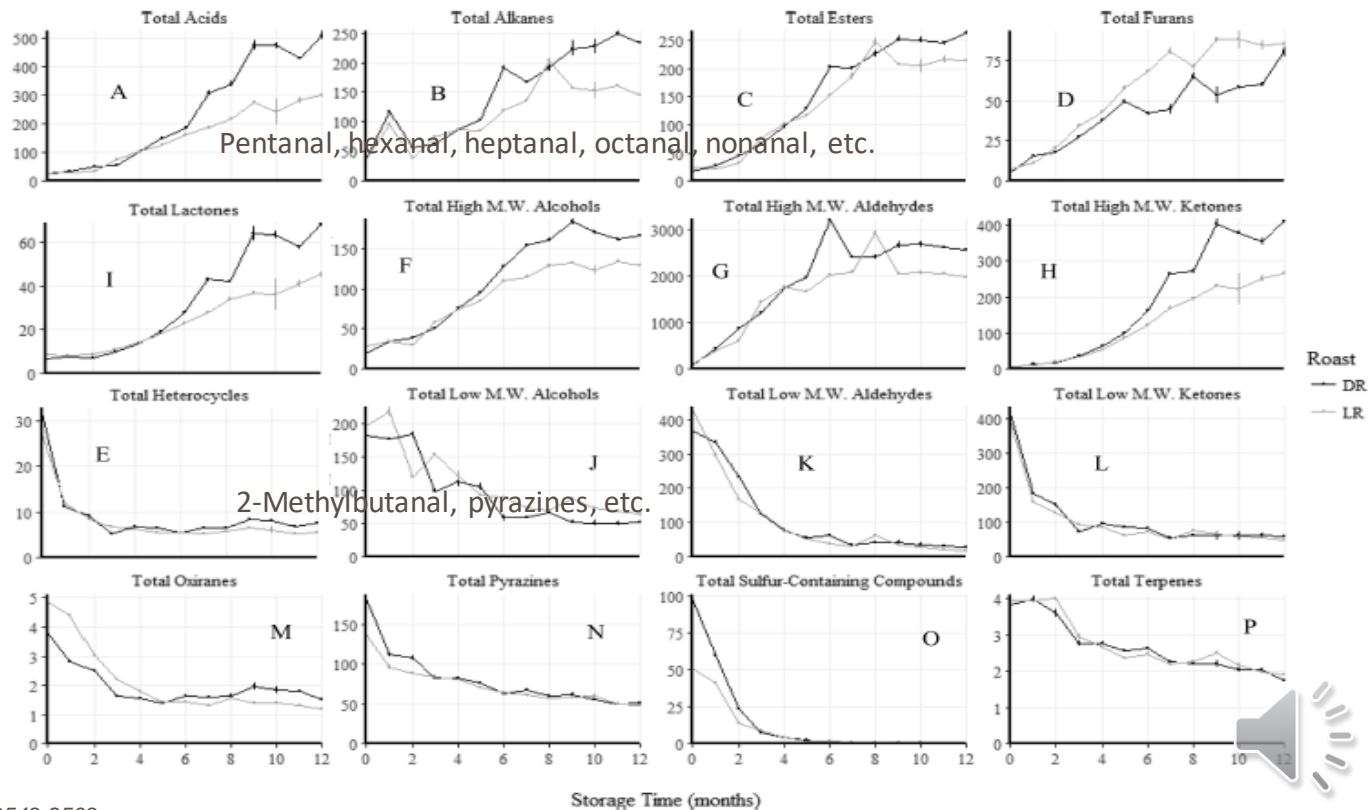
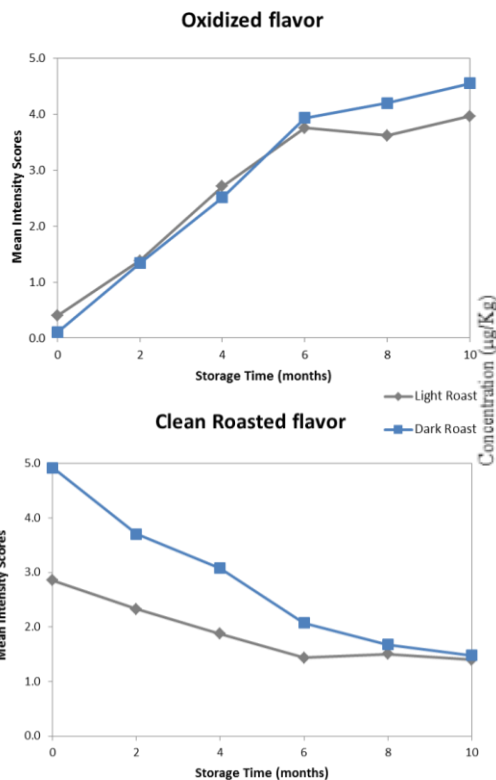


# Roasting Optimization

# Roast Flavor Volatiles in Roasted Almonds Fade Away and Off-flavor Volatiles Increase Over Time



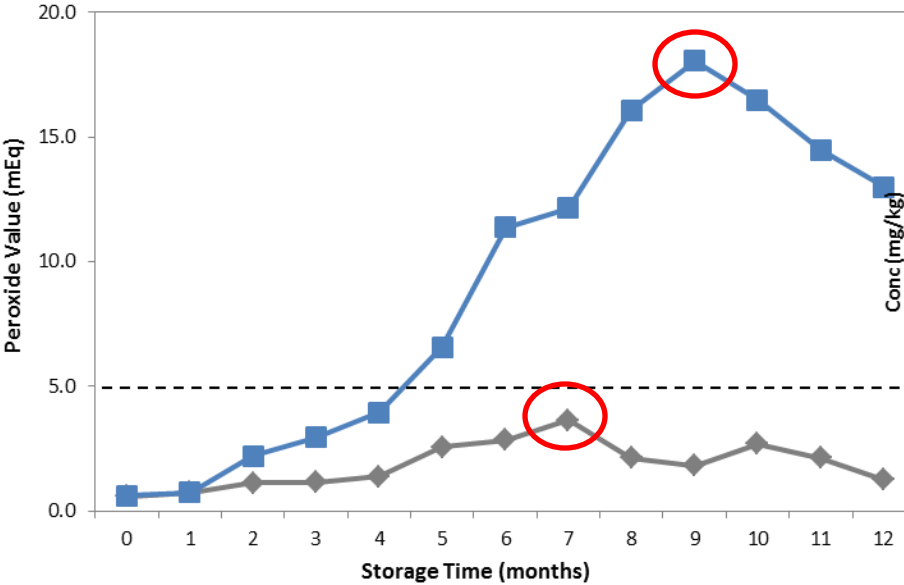
# Nutty and Roasted Flavors Fading and Oxidized Flavors Increasing Over Time, Dark Roasted Degrade Faster Than Light Roasted



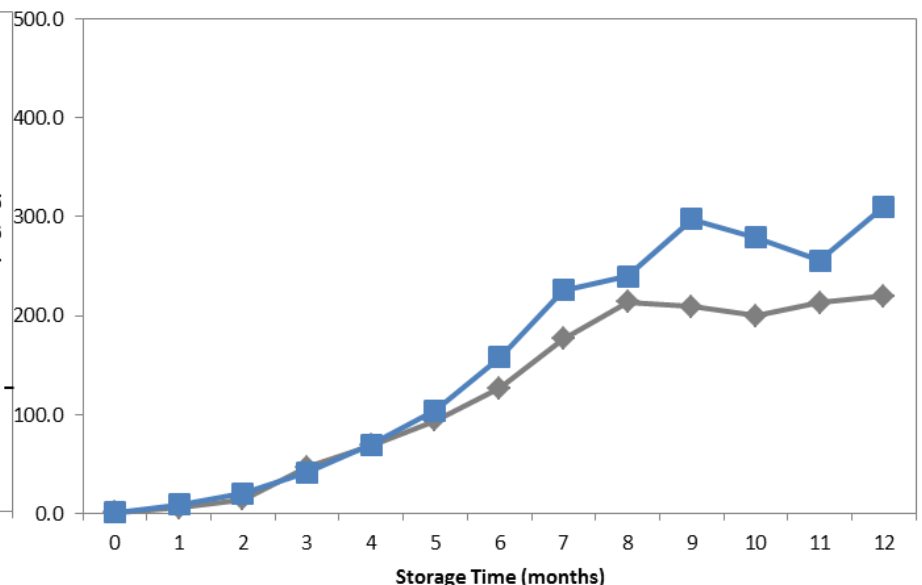


# Quality of Dark Roasted Almonds Deteriorate Faster

### Peroxide Value (PV)



### Octanal



Franklin et al., J. Agric. Food Chem. 2017, 65(12), 2549-2563

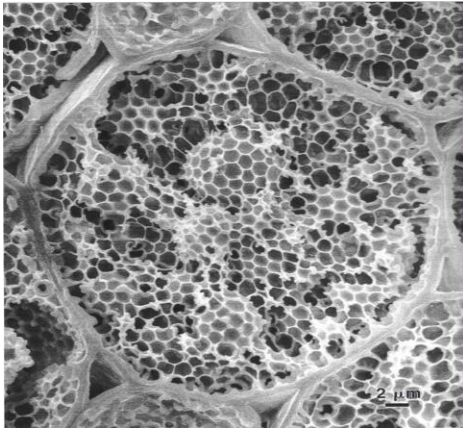


# Impact of Roasting Temperature on Cellular Structure (Low to High; Low/High vs. High/Low)

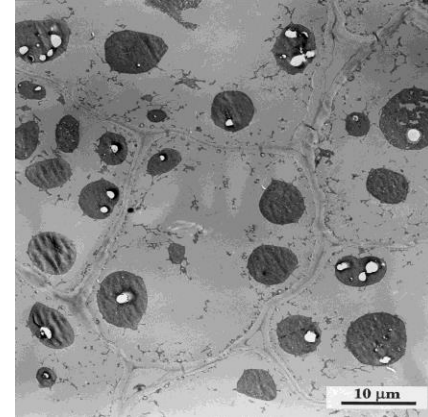


# Impact of Roasting on Cellular Structure and Shelf Life

- Cell compartmentation is destroyed, cell-to-cell junctions become impaired, inner surface is enlarged.
- Increasing roasting temperatures accelerates microstructure modifications.

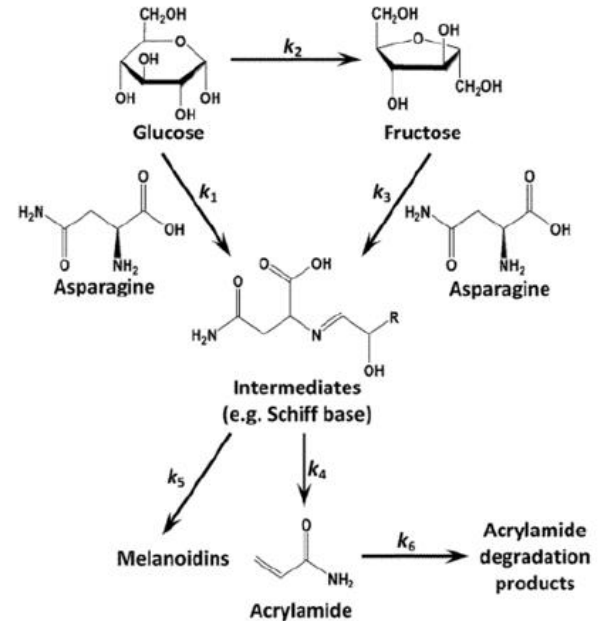


**ROASTING**



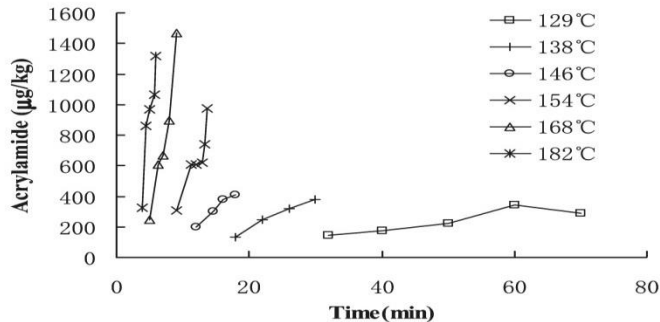
# Acrylamide in High-Temperature Cooked Foods

- A precursor chemical to produce polyacrylamides, a water- soluble thickeners
- Been reported causing cancer in laboratory animals at high levels
- Acrylamide reported in heat processed starch rich foods by Swedish scientists in 2002
- Can form naturally between sugars and asparagine, an amino acid in plant-based foods including potato, grains, etc. at high-temperature processes ( $>121^{\circ}\text{C}$ )
- No standard or limit established by any countries or international organizations
- California Proposition 65 requires a label warning for acrylamide at a default level of 10ppb.



# Roasting Almonds Light for Minimal Acrylamide

- Raw almonds rich in free asparagine, glutamine, and reducing sugars (glucose, fructose)
- Roasting processes will result in formation of various levels of acrylamide



**Figure 2.** Influence of time at different roasting temperatures on the acrylamide content of almonds (Carmel variety).

- Both roasting temperature and time increase acrylamide formation
- Temperature shows a more significant effect than time
- Increasing time at the same temperature increase acrylamide, but more significantly above 146°C
- Roasting almonds at or below 138°C with a roasting time for light degree of roasting to minimize formation of acrylamide



# Recommendations for Roasting

- Minimize impact of roasting on quality
  - Target for light to medium roast
  - Target for a final moisture of 1.5 to 3%
  - Roasting at a temperature below 138°C, ideally below 129°C
  - Two stage roasting of low/high temperature zones reduces cellular destruction
- Stop oxidation or damaging
  - Prompt cooling after roasting
- Slow down or prevent quality deterioration
  - Packing under nitrogen flush or vacuum
  - Use high barrier packaging material





Thank you for attention!

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