

## **Defining the sensory profiles of raw almond (*Prunus dulcis*) varieties and the contribution of key chemical compounds and physical properties**

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### **Highlights**

- This study defined the sensory profiles of major sweet California almond varieties and their consistency over two harvest years, and determined how chemical and physical measures of the varieties impacted key sensory attributes.
- Almond varieties were primarily differentiated by texture attributes in both years.
- Almond varieties were less differentiated by flavor than by texture, and flavor was less consistent across the two years—flavor may be influenced more by external factors, such as orchard practices or environmental factors, than by varietal composition.

### **Summary**

Almond varieties in California are typically classified by the size, shape and blanchability of the nut kernel and the hardness of the shell. Although major California almond varieties have similar macronutrient and micronutrient profiles, variability can be expected within and among varieties because almonds are natural products. Almond varieties also can differ in their chemical profiles, including volatile and non-volatile compounds, and in their sensory profiles.

In this study, almond samples from 13 varieties were analyzed by descriptive sensory analysis using a trained sensory panel evaluating aroma, flavor, and texture attributes. The sensory descriptive analysis was analyzed separately for the two harvest years, both for the almond samples and at the variety level, and the results were compared.

Differences in the sensory profiles of almond samples and varieties were observed across the two harvest years. Of the 35 attributes evaluated, 19 were significantly different at both the sample and variety levels across the two years (e.g., sweet taste, total flavor intensity, marzipan/benzaldehyde flavor, hardness, crunchy, astringent). Only three attributes (i.e., marzipan/benzaldehyde aroma, rubber/medicinal flavor, total off flavor) were similar among the samples and varieties in both years, indicating that these attributes are not important in differentiating varieties. The other attributes were found to be significantly different at the sample and variety levels in one of the years.

In general, Aldrich, Fritz, Wood Colony, and Price varieties had consistent sensory profiles in each year, whereas other varieties showed larger sensory variation within a year, such as Nonpareil (2015 and 2016), Monterey (2015), Carmel (2016), and Butte/Padre (2016). Variability was greater within varieties from the 2016 harvest, which may be an element of sampling or external factors during the growing season.

*Texture:* Almond varieties from both years were primarily differentiated by texture attributes. When the chemical measures were overlaid on the 2016 sensory profiles, moisture content was positively associated with moistness, cohesiveness of mass, and chewiness, and negatively associated with fracturability, hardness, and crunchiness.

- Independence, Sonora, and Wood Colony were harder, more fracturable, and crunchier, whereas Fritz and Monterey were moister and chewier, which reflected their higher moisture content.

*Flavor and aroma:* Interestingly, flavor differentiated the samples less than texture, and flavor was less consistent across the harvest years. This finding may indicate that flavor is influenced more by external factors, such as orchard practices or environmental factors, than by varietal composition.

- Aldrich and Fritz were higher in total flavor intensity and marzipan/benzaldehyde flavor, which reflected their higher concentrations of amygdalin, benzaldehyde, phenylethyl alcohol, and benzyl alcohol. Marzipan/benzaldehyde flavor was positively associated with amygdalin, benzaldehyde, phenylethyl alcohol and benzyl alcohol, and negatively associated with hexanal and pentanal when the chemical analyses were overlaid.
- In both years, Aldrich was also higher in sweet taste and sweet aromatic flavor, Nonpareil was higher in total aroma intensity, woody aroma/flavor, and hay aroma, and Sonora tended to be higher in hay aroma/flavor when compared with other varieties.
- Carmel, Wood Colony and Price had relatively intermediate aroma and flavor profiles. Butte and Mission were both generally lower in total aroma and flavor intensity, with intermediate texture profiles.

## Methodology

Raw, whole almonds (*Prunus dulcis*) were obtained from different commercial almond growers in the Central Valley of California from two harvest years: 13 varieties (43 samples) in 2015, and 10 varieties (40 samples) in 2016.

All almond samples were analyzed by descriptive sensory analysis in duplicate using 10 trained panelists and 35 sensory attributes, including aroma, flavor and texture. Panelists rated the intensity of 10 aroma, 12 flavor, and 13 texture attributes.

Almond samples collected in 2016 also were analyzed for chemical compounds and physical measures, including 19 macro- and micro-nutrients, moisture content, amygdalin, and 51 volatile compounds by headspace solid-phase microextraction (HS-SPME) gas chromatography mass spectrometry (GC/MS). The results of the 2016 sensory and chemical data were modeled.

## Reference

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