



Consumer Test of Spring-Planted, Day-Neutral Strawberries Grown in a High Tunnel System

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Introduction

Strawberries are prone to damage from high summer temperatures in the central U.S. due to their porous nature; therefore, fall-planted, June-bearing cultivars are commonly grown in the region with a late-spring harvest (Kadir et al., 2006). However, new research trends show that certain varieties of spring-planted, day-neutral strawberries grown in the central U.S. with a May-October production period, can reach optimum yields and marketability when grown in high tunnel production (Gude et al., 2017). Locally grown strawberries are cited as one of the top 10 crops of interest for local growers and local buyers (KC Public Food Hub Feasibility Study, 2015). It is reported that the top three reasons consumers support local food in the U.S. in order of importance are freshness, support of the local economy, and taste (FMI, 2014). Therefore, consumer preference is important to understand the variety acceptance of the locally grown fruit, based on its freshness and taste. Consumers purchase produce based on visual appearance and textural quality, while repeat purchases are determined on organoleptic taste quality (i.e. taste, aroma) (Kader, 1988). Color is the consumer's initial visual quality parameter (Kays, 1999). Sweetness intensity is the primary factor contributing to overall liking for consumer (Schwieterman et al., 2014). Texture is an important parameter of physical firmness; this indicates freshness, because strawberries lose turgidity as they age throughout storage (Woodward, 1972). The goal of this work was to investigate the quality of several day-neutral varieties within high tunnel conditions, and to identify the overall likeness through a large consumer acceptance study based on measured quality parameters (sweetness, texture, flavor, color).

Objectives

- Identify spring-planted day-neutral varieties that perform optimally based on their overall likeness scores in a consumer acceptance study based on the following parameters: redness, flavor, texture, sweetness.
- Determine how the consumer acceptance scores of overall likeness, redness, texture, flavor, and sweetness compare to the measured quality parameters of color, texture, titratable acidity, and soluble solids.

Methodology

High Tunnel Trials: Strawberries were grown in a three-season high tunnel (200' x 24') with 30% shade cloth at the Olathe Horticulture Research and Extension Center (OHREC) in 2014 and 2015.

- Commercial varieties include: 'Albion', 'Evie2', 'Monterey', 'Portola', 'San Andreas', and 'Seascape'.

Consumer Analysis Study: 170 participants on July 25, 2015 and 50 participants on August 3, 2015.

- Randomized block pattern (Lawless and Heymann, 1998).
- Five cultivars were studied ('San Andreas' not used due to low yields).

How much do you like or dislike these strawberries OVERALL?

9-point Hedonic rating scale (Peryam and Girardot, 1952).

- Fruit scored above a 5 (neither like nor dislike) was considered acceptable.

<input type="checkbox"/> Like extremely (9)	<input type="checkbox"/> Like very much (8)	<input type="checkbox"/> Like moderately (7)	<input type="checkbox"/> Like slightly (6)	<input type="checkbox"/> Neither like nor dislike (5)	<input type="checkbox"/> Dislike slightly (4)	<input type="checkbox"/> Dislike moderately (3)	<input type="checkbox"/> Dislike very much (2)	<input type="checkbox"/> Dislike extremely (1)
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The acceptance test identified which cultivar was liked overall to determine the influence of each sensory attribute.

Describe the COLOR	Describe the SWEETNESS	Describe the OVERALL FLAVOR	Describe the TEXTURE
<input type="checkbox"/> Much too red	<input type="checkbox"/> Much too sweet	<input type="checkbox"/> Much too strong	<input type="checkbox"/> Much too firm
<input type="checkbox"/> Slightly too red	<input type="checkbox"/> Slightly too sweet	<input type="checkbox"/> Slightly too strong	<input type="checkbox"/> Slightly too firm
<input type="checkbox"/> Just about right	<input type="checkbox"/> Just about right	<input type="checkbox"/> Just about right	<input type="checkbox"/> Just about right
<input type="checkbox"/> Not quite red enough	<input type="checkbox"/> Not quite sweet enough	<input type="checkbox"/> Not quite strong enough	<input type="checkbox"/> Not quite firm enough
<input type="checkbox"/> Not at all red enough	<input type="checkbox"/> Not at all sweet enough	<input type="checkbox"/> Not at all strong enough	<input type="checkbox"/> Not at all firm enough

Quality Analysis: measured on day of harvest

- Color (CIE L*a*b*);
- Organoleptic Analysis (Titratable Acidity and Soluble Solids); and
- Texture (N).

Results

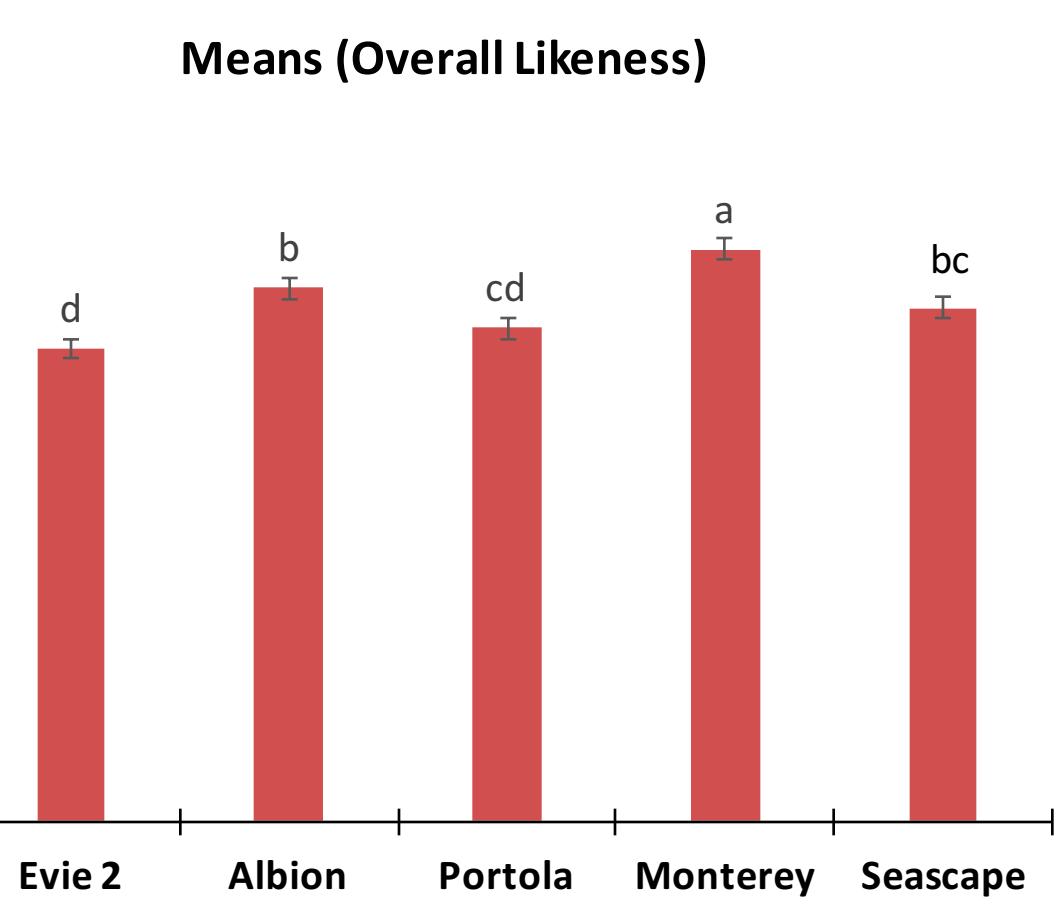
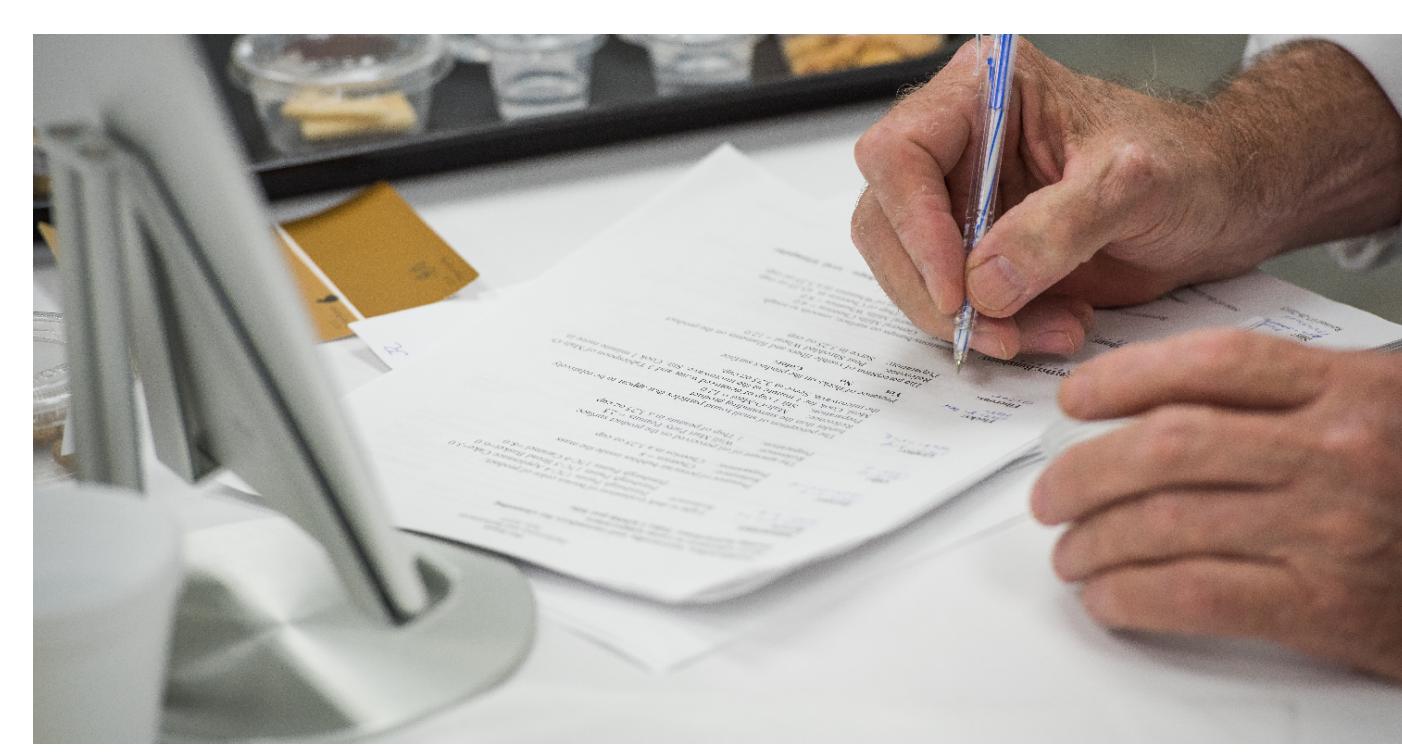


Figure 1. Hedonic Scale (1-9) scores for Overall Likeness.

Varieties marked with different letters are significantly different ($\alpha \leq 0.05$). Tukey's comparison.

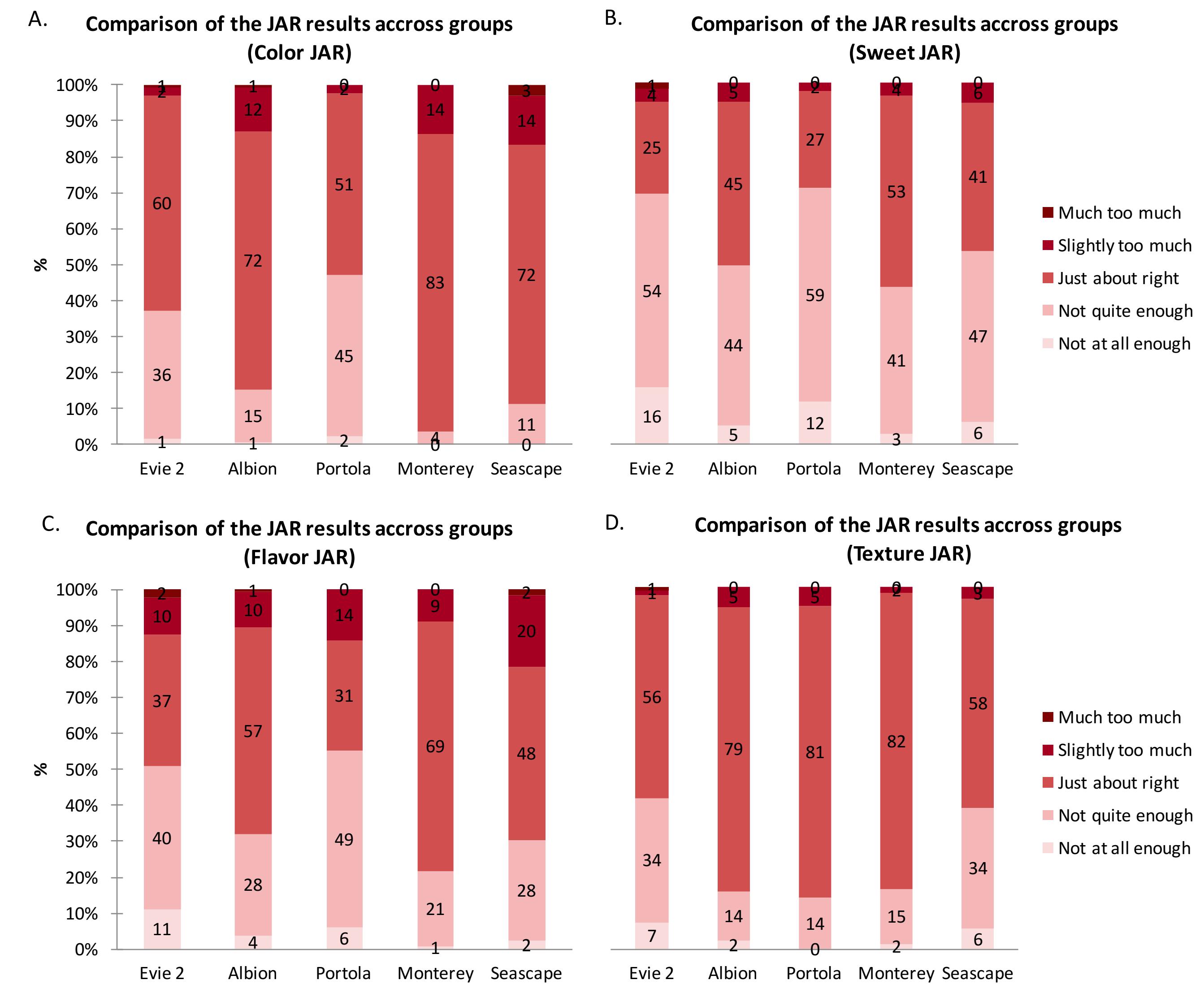


Figure 2. Acceptance Test Sensory Attributes from all participants (N=250) for each variety.

(A) Color percentage scores. (B) Sweetness percentage scores. (C) Flavor percentage scores. (D) Texture percentage scores.

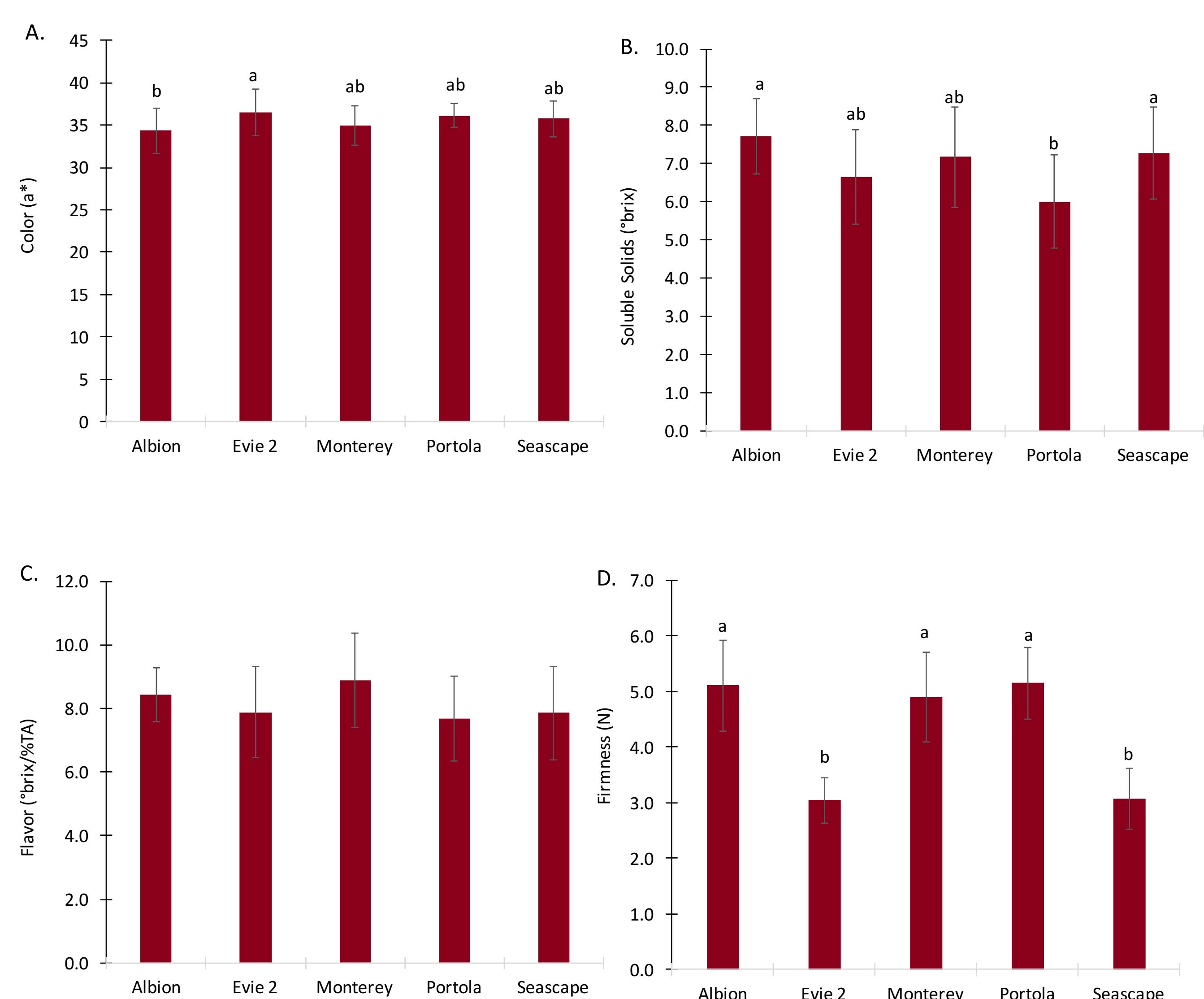


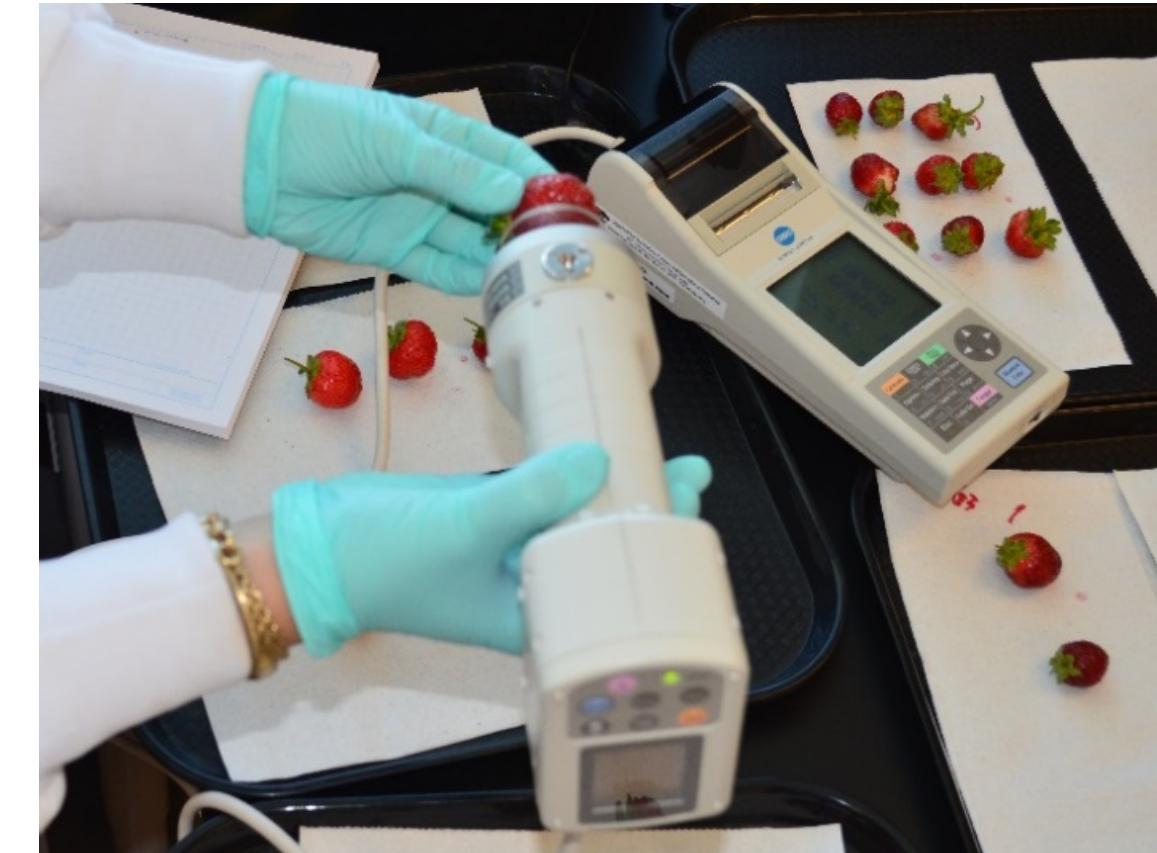
Figure 3. Quality parameter analysis on Day 0 of all four 2015 harvests for each variety.

(A) Color (a*) values. (B) Soluble Solids (°brix). (C) Flavor ratio (°brix/%TA). (D) Firmness (N). Varieties marked with different letters are significantly different ($\alpha \leq 0.05$). Tukey's comparison.

Results



- Of the sensory attributes, sweetness was the most correlated to overall likeness ($R^2=0.56$).
- All studied varieties scored >6 for overall likeness (Fig. 1).
- 'Monterey' was significantly high for overall likeness in comparison to the other varieties (Fig. 1), with 'Albion' as a close second.
- A large majority (83%) of participants said 'Monterey' color was JAR, while 72% of participants said 'Albion' and 'Seaside' color was JAR (Fig. 2A).
- Only 53% of participants said 'Monterey' sweetness was JAR. Many participants believed that most of the varieties contained not quite enough sweetness (Fig. 2B).
- 69% of the participants scored 'Monterey' flavor as JAR with 'Albion' at 57% JAR (Fig. 2C).
- Over 50% of participants said that the texture of all 5 varieties was JAR, with 'Monterey', 'Portola', and 'Albion' as the most like varieties (82, 81, and 79%, respectively) (Fig. 2D).



- Of the measured quality parameters, 'Albion' was the darkest red berry in comparison to the others ($P < 0.0266$), closely followed by 'Monterey' and 'Seaside' (Fig. 3A).
- 'Albion' and 'Seaside' had higher °brix ($P < 0.0032$) than the other varieties, closely followed by 'Monterey' (Fig. 3B).
- 'Monterey' had the highest flavor ratio, with 'Albion' as a close second. There was no significant difference amongst varieties in regards to the flavor ratio (Fig. 3C).
- Firmness amongst varieties was significantly greater with 'Albion', 'Monterey', and 'Portola' ($P < 0.0001$) (Fig. 3D).

Conclusion

The five spring-planted, day-neutral cultivars were considered above acceptable for overall likeness by a large consumer panel (N=250). Sweetness had the greatest correlation to overall likeness. 'Monterey' had the highest overall likeness from the consumers regarding the color, sweetness, flavor, and texture of the fruit. The sensory results are in agreement with the flavor of 'Monterey' fruit on the day of harvest. 'Albion' was the second highest regarded variety by consumers, with 'Seaside' in third place. In comparison to the analytical quality measurements, 'Albion', 'Monterey', and 'Seaside' contained the highest levels of soluble solids, while 'Monterey' had the highest flavor ratio. The analytical firmness measurements tended to show the same results as the consumer scores for fruit texture.

References and Acknowledgements

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