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Ripeness attributes of Arkansas-grown peaches and nectarines at harvest and during postharvest storage

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Cover Page Footnote

Mary Siebenmorgen is a December 2018 Honors program graduate with a major in Food Science. Renee T. Threlfall is a faculty mentor and a research scientist in the Department of Food Science. Margaret Worthington is a thesis committee member and assistant professor in the Department of Horticulture.

Ripeness attributes of Arkansas-grown peaches and nectarines at harvest and during postharvest storage

Meet the Student-Author

Mary Siebenmorgen

As an Arkansas native, the University of Arkansas has always been near to my heart. Growing up on a cattle farm in Scranton, Arkansas has made me conscious of the importance of agriculture to our society. After graduating from Scranton High School as the valedictorian, I attended Colorado State University. After my freshman year, I missed what Arkansas had to offer. My interest in food science and horticulture led me to Bumpers College. The University of Arkansas has opened endless opportunities. My experiences as an Honors College student, a Bumpers College ambassador, and the Food Science Club Vice President allowed me to connect with students and faculty. My interest in fruit flourished after working as a laboratory and harvest assistant at the Division of Agriculture's Fruit Research Station in Clarksville. This opportunity connected me with my mentor whom I began working with on undergraduate research in the Food Science Department. Last summer I was a viticulture and enology intern at Post Familie Winery and Vineyard in Altus, Arkansas. I intend to pursue a graduate degree and seek employment in the fruit and wine industry. I would like to thank my thesis advisor, Dr. Renee Threlfall and her graduate student, Molly Felts for the help they offered throughout my research. I would also like to thank my thesis committee, Dr. Margaret Worthington and Dr. Luke Howard, for their guidance and use of laboratories. Last but not least, I would like to thank my family for helping with harvesting the fruit and supporting me throughout my studies and research.

Research at a Glance

- The postharvest potential of the peaches and nectarines was dependent on the fruit genotype (cultivar or selection).
- When picking fruit to ripen during storage (commercially ripened fruit) the ripeness attributes were impacted. Commercially ripened fruit had higher chlorophyll, acidity, and firmness than tree-ripened fruit. However, tree-ripened fruit had slightly higher fruit weight, soluble solids, and pH than commercially ripened fruit.
- Evaluation of ripeness attributes helps determine optimal harvest time, handling, and storage of peaches and nectarines for growers in Arkansas and other regions, and provides insight into potential new peach and nectarine cultivar releases from the University of Arkansas System Division of Agriculture breeding program.

Mary Siebenmorgen measuring the firmness of a peach using a texture analyzer.

Ripeness attributes of Arkansas-grown peaches and nectarines at harvest and during postharvest storage

Mary Siebenmorgen, Renee T. Threlfall†, and Margaret Worthington§*

Abstract

Since peaches and nectarines are a valued fresh-market crop worldwide, evaluating postharvest potential helps determine feasibility for commercial markets. The ripeness attributes of 10 peach and nectarine genotypes (cultivars and advanced breeding selections) were evaluated at harvest (day 0) and after 7 and 14 days storage at 4 °C. Five cultivars (Amoore Sweet, Bowden, Bradley, Effie, and Souvenirs) and five advanced selections (A-663 CN, A-811 CN, A-794 CN, A-819, and A-885) were evaluated. The fruit was hand harvested at tree ripeness (ripened on the tree) and commercial ripeness (ripened during storage). The attributes of the tree-ripened fruit and commercially ripened fruit varied at harvest and included chlorophyll [0.04–0.86 absorbance (abs)], peach weight (132–264 g), soluble solids (7.23–12.57%), pH (3.18–4.66), titratable acidity (0.16–1.21%), and flesh firmness [6.92–35.72 newtons (N)]. In general, tree-ripened fruit had higher fruit weight, soluble solids, and pH and lower chlorophyll, titratable acidity, and firmness than commercially ripened fruit at harvest. For the tree-ripened fruit, A-811 CN was the largest (247.67 g), A-794 CN had the highest soluble solids (12.57%) and titratable acidity (0.88%), Souvenirs (6.92 N) had the lowest firmness, and Amoore Sweet (18.28 N) was the firmest. During storage of commercially ripened fruit, chlorophyll and fruit weight decreased, while soluble solids increased, but there were no changes in pH or titratable acidity. During storage, A-885 (0.35 abs) had the lowest chlorophyll, and Effie had the largest fruit (203.11 g) and highest soluble solids (12.02%). Some ripeness attributes of the commercially ripened fruit, such as chlorophyll and weight, were not achieved as compared to the tree-ripened fruit. The results of this study provide insight on the potential for releasing new peach and nectarine genotypes from the University of Arkansas System Division of Agriculture's Fruit Breeding Program.

* Mary Siebenmorgen is a December 2018 honors program graduate with a major in Food Science.
† Renee T. Threlfall is a faculty mentor and a research scientist in the Department of Food Science.
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Introduction

Peaches and nectarines (*Prunus persica* L.) are a valuable fresh-market crop worldwide and are classified as climacteric fruit, fruit that ripens after harvest. Peaches and nectarines can vary greatly in shape (round, flat, or beaked), skin type (pubescent or smooth-skinned), stone type (freestone or clingstone), flesh color (white, yellow, or red), and flesh type (melting, slow melting, or non-melting) with a wide range of sweetness and acidity (Brovelli et al., 1999). Melting-flesh peaches are commonly used in fresh market, and the tertiary ripening phase is generally called the "melting" stage (Ghiani et al., 2011). The difference between melting and non-melting peaches is increased enzymatic capacity for pectin degradation in melting-flesh types (Maw, 2003). Peaches and nectarines are the same genetically, except nectarines lack the gene variant responsible for the fuzzy exterior.

Peaches and nectarines are soft-fleshed and highly perishable fruits, with a limited market life. The maturity at which peaches are harvested greatly influences their flavor, market life, and quality potential. Crisosto and Valero (2008) found that peaches harvested too soon for commercial storage can fail to ripen properly and green ground color (greenish skin around the stem) may never fully disappear. Generally, immature and low-maturity fruit can have inadequate flavor development, which can lead to decreased consumer acceptance. However, overripe fruit can have a shortened postharvest life by the time this fruit reaches the consumers.

Optimum maturity must be defined for each peach cultivar for maximum taste and storage quality, but in all cases, it should assure that the fruit has the ability to ripen satisfactorily (Kader and Mitchell, 1989). The ideal maturity of the fruit varies according to markets; for example, a tree-ripened peach will be recommended for local markets while a commercially ripened peach is for distant markets. Maturity indices used from different production areas have reported that flesh color, firmness, and background color changes are correlated to chemical and physical fruit changes during maturation and ripening (Brovelli and Sims, 1998).

A key factor in understanding the fruits' potential for commercial markets is evaluating the postharvest attributes. Postharvest can be defined as the period of time from the moment of harvest to the point of consumption (Florkowski et al., 2014). Post-harvest attributes of fresh-market produce can be related to aroma, texture, flavor, nutraceuticals, composition, and transportation and handling of the product. Peaches immediately begin to deteriorate after harvest, but this process can be delayed when the fruit is refrigerated during storage. However, cold storage can cause damage to fruit quality through browning (both skin and flesh), flesh breakdown, loss of juiciness (mealiness or woolliness), discoloration, and loss of flavor (Lauxmann et al., 2014).

The Fruit Breeding Program at the University of Arkansas System Division of Agriculture was founded in 1964 by Dr. James N. Moore. Since then, the program has released over 50 different fruit cultivars including blackberries, table grapes, wine grapes, peaches/nectarines, strawberries, and blueberries (J.R. Clark, pers. comm.). The program focuses on developing fruit cultivars for commercial markets and nurseries with production extending beyond Arkansas to other states and countries. The Fruit Breeding Program, located at the Fruit Research Station in Clarksville, Arkansas, is actively evaluating fruit, including peaches and nectarines, for potential release, and has released 12 fresh-market peach and nectarine cultivars.

The objective of this study was to evaluate ripeness attributes of Arkansas-grown peaches and nectarines at harvest and during postharvest storage and to provide insight for release of new peach and nectarine cultivars from the University of Arkansas System Division of Agriculture's Fruit Breeding Program.

Materials and Methods

Plants and Harvest

Ten peach and nectarine genotypes (cultivars and advanced selections) were grown and harvested from the Fruit Research Station, Clarksville Arkansas in 2017. Five cultivars (Amoore Sweet, Bowden, Bradley, Effie, and Souvenirs) and five advanced selections (A-663 CN, A-811 CN, A-794 CN, A-819, and A-885) were evaluated in this study (Table 1). The peaches and nectarines were hand harvested on 23 June in the morning (about 7:00-10:00 AM).

Twelve fruit were harvested per genotype, nine commercially ripened fruit (fruit picked early to ripen during storage) and three tree-ripened fruit (fruit ripened on the tree). The fruit ripeness was screened using a Delta Absorbance (DA) meter (Sintéleiax, Bologu, Italy) to analyze the Chlorophyll A content of the fruit skin (difference of absorbance between 670–720 nm). The standard for commercially ripened fruit using the DA meter was an I_{AD} value of 0.5 to 1.0, and a value below 0.25 indicated physiological maturity of tree-ripened fruit. The peaches and nectarines were harvested for each genotype and placed randomly onto pre-labeled corrugated pulp trays with individual wells for each fruit, with one tray per genotype. The fruit was evaluated for physiochemical attributes at day 0, 7, and 14 at 4 °C with 85–89% relative humidity.

Physiochemical Analysis

Fruit for physiochemical analysis was evaluated in triplicate per ripeness and genotype. Each replicate was an individual peach or nectarine. The physiochemical analysis included fruit weight, flesh firmness, and composition evaluated at 0, 7, and 14 d at 4 °C. After harvest, fresh fruit weight, and firmness were evaluated at the Fruit Research Station, then fruit for compositional analysis was frozen (-10 °C) for analysis at the Food Science Department in Fayetteville, Arkansas.

Weight. Fruit weight was measured on a digital scale (Mettler Toledo JL6001GE, Columbus, Ohio) in triplicate. Fruit weight was the weight of a whole, intact peach or nectarine.

Firmness. Flesh firmness was measured using a Stable Micro Systems TA.XT2 Texture Analyzer (Texture Technologies Corporation, Hamilton, Massachusetts). Prior to the firmness measurement, a section of the fruit skin was removed by slicing off a 5-mm section. The fruit was then placed on a flat surface. Firmness of the fruit flesh was evaluated at three locations per fruit (90°, 180°, and 270° to the right of the suture) using the 2-mm-diameter probe, at a rate of 2 mm/s with a trigger force of 0.02 N. Force to penetrate the fruit flesh was measured in Newtons (N).

Composition. The fruit half for composition was frozen (-10 °C) then thawed for analysis of soluble solids, pH, and titratable acidity. The other half of the fruit was used for analysis not reported in this manuscript. Each fruit half (skin and flesh) was macerated in a blender, then the juice was centrifuged at 5000 rpm for 8 min and strained through cheese cloth. The pH and titratable acidity were measured using the Titrino plus 862 compact titrosampler (Metrohm AG, Herisan, Switzerland) with the electrode standardized to pH 4.00, 7.00, and 10.00 buffers. Titratable acidity was determined using ~6 g of juice diluted with 50 mL deionized, degassed water with a titration using 0.1 N sodium hydroxide to an endpoint of pH 8.2. Titratable acidity was expressed as percentage of malic acid. Soluble solids (expressed as percent) were measured using an Abbe Mark II refractometer (Bausch and Lomb, Scientific Instrument, Keene, New Hampshire).

Statistical Design and Analysis

After harvest, the fruit from each of the two ripeness types and ten genotypes were completely randomized. The fruit was stored at 4 °C for 0, 7, and 14 d. Statistical analyses were conducted using JMP® v. 13.2.0 (SAS Institute, Cary, North Carolina). A univariate analysis of variance (ANOVA) was used to determine the significance of main factors and interactions. Tukey's Honestly Significant Difference (HSD) test was used to detect significant differences ($P < 0.05$) among means and verify interactions at 95% significance level. Physiochemical attributes were evaluated in triplicate.

Results and Discussion

At harvest and during storage, the peaches and nectarines were within a commercially acceptable range for the attributes evaluated (chlorophyll, fruit weight, soluble solids, pH, titratable acidity, and firmness). The tree- and commercially ripened fruit were evaluated for physiochemical attributes at harvest, and the commercially ripened fruit was evaluated for physiochemical attributes during storage.

Physiochemical Attributes at Harvest

At harvest for the tree-ripened fruit, the peaches and nectarines had a chlorophyll of 0.04–0.17 abs, fruit weight of 142.33–247.67 g, soluble solids of 7.80–12.57%, pH

Table 1. Fresh-market peach and nectarine genotypes harvested 23 June 2017 from the University of Arkansas System Division of Agriculture's Fruit Research Station, Clarksville, Arkansas.

Genotype	Type	Flesh color	Flesh type	Acid type
A-663 CN	Nectarine	Yellow	Non-melting	High
A-794 CN	Nectarine	White	Non-melting	High
A-811 CN	Nectarine	Yellow	Non-melting	High
A-819	Peach	Yellow	Melting	Low
A-885	Peach	White	Melting	Low
Amoore Sweet	Nectarine	Yellow	Non-melting	Low
Bowden	Nectarine	White	Non-melting	High
Bradley	Nectarine	Yellow	Non-melting	High
Effie	Nectarine	White	Non-melting	Low
Souvenirs	Peach	Yellow	Melting	Low

of 3.43–4.66, titratable acidity of 0.17–0.88%, and firmness of 6.92–18.28 N (Table 2). There were no significant differences between genotypes for chlorophyll or fruit weight. The average chlorophyll level and fruit weight for these genotypes were 0.12 abs and 204.90 g, respectively. These chlorophyll levels at harvest were expected since the DA meter was used to screen the fruit. Although not significantly different, A-811 CN was the largest fruit and Effie, the smallest. Previously reported fruit weight for Amoore Sweet, Bowden, Bradley, and Souvenirs was lower than fruit in this research (Clark and Sandefur, 2013a; 2013b, Clark et al., 2001). There were significant differences between genotypes for soluble solids, pH, titratable acidity, and firmness. A-663 CN (7.80%) and A-819 (8.33%) had lower soluble solids than A-794 (12.57%). A-885 (0.17%) had lower titratable acidity than A-794 CN (0.88%). Clark and Sandefur (2013a) reported two-year averages of soluble solids for Amoore Sweet (17.3%), Bowden (14.9%), Bradley (14.8%), and Souvenirs (14.1%), which were higher than the soluble solids of fruit in this study. There was a high incidence of rainfall in Clarksville in 2017 prior to harvest of the fruit, which could have caused the lower soluble solids in this study. A-819, Souvenirs, A-885 and Amoore Sweet had higher pH values than the other genotypes. Souvenirs and A-819 had lower firmness than Amoore Sweet and Effie. Amoore Sweet is

Table 2. Physiochemical attributes of tree-ripened and commercially ripened fresh-market peach and nectarine genotypes at harvest (day 0), University of Arkansas System Division of Agriculture's Fruit Research Station, Clarksville, Arkansas (2017).

Ripeness	Genotype	Chlorophyll† (abs)	Fruit weight (g)	Soluble solids (%)	pH	Titratable acidity‡ (%)	Firmness (N)
Tree	A-663 CN	0.09 a§	177.33 a	7.80 b	3.77 b	0.63 abc	10.61 ab
	A-794 CN	0.15 a	207.67 a	12.57 a	3.55 b	0.88 a	9.42 ab
	A-811 CN	0.04 a	247.67 a	9.30 ab	3.52 b	0.51 a-d	10.61 ab
	A-819	0.15 a	214.33 a	8.33 b	4.66 a	0.40 cd	7.81 b
	A-885	0.15 a	199.67 a	10.60 ab	4.56 a	0.17 d	9.15 ab
	Amoore Sweet	0.12 a	232.67 a	10.40 ab	4.43 a	0.48 bcd	18.28 a
	Bowden	0.17 a	207.33 a	9.40 ab	3.43 b	0.84 ab	12.90 ab
	Bradley	0.05 a	210.00 a	9.17 ab	3.56 b	0.76 abc	11.36 ab
	Effie	0.18 a	142.33 a	10.90 ab	3.80 b	0.39 cd	18.03 a
	Souvenirs	0.07 a	210.00 a	10.77 ab	4.57 a	0.41 cd	6.92 b
P-value		*0.2468*	*0.0599*	*0.0119*	*<0.0001*	*<0.0001*	*0.0045*
Commercial	A-663 CN	0.86 a	132.00 b	8.15 bc	3.49 c	0.78 bc	23.37 ab
	A-794 CN	0.52 abc	135.33 b	9.30 bc	3.18 c	1.21 a	32.67 a
	A-811 CN	0.51 abc	198.00 ab	8.83 bc	3.39 c	0.93 b	20.97 ab
	A-819	0.59 abc	178.33 ab	7.23 c	4.62 a	0.46 d	9.06 b
	A-885	0.39 bc	163.00 ab	12.17 a	4.54 a	0.16 e	20.14 ab
	Amoore Sweet	0.63 abc	217.67 ab	8.70 bc	4.33 a	0.58 cd	28.09 ab
	Bowden	0.71 abc	212.33 ab	9.70 abc	3.29 c	0.94 ab	22.95 ab
	Bradley	0.82 ab	191.67 ab	7.70 bc	3.33 c	0.74 bcd	15.72 ab
	Effie	0.80 ab	264.00 a	9.60 bc	3.61 bc	0.49 d	27.48 ab
	Souvenirs	0.32 c	181.67 ab	9.90 ab	4.15 ab	0.47 d	35.72 a
P-value		*0.0029*	*0.0064*	*<0.0001*	*<0.0001*	*<0.0001*	*0.0075*

† Chlorophyll A of fruit skin measured by Delta Absorbance (DA) Meter (difference of absorbance between 670–720 nm) as an indicator of fruit ripeness.

‡ Calculated as percent malic acid.

§ Genotypes were evaluated in triplicate. Means with different letter(s) for each attribute within ripeness are significantly different ($P < 0.05$) using Tukey's honestly significant difference.

a non-melting flesh nectarine with a flesh type that is very firm and rubbery in texture (Sandefur, 2011).

At harvest for the commercially ripened fruit, the peaches and nectarines had a chlorophyll of 0.32–0.86 abs, fruit weight of 132.00–264.00 g, soluble solids of 7.23–12.17%, pH of 3.18–4.62, titratable acidity 0.16–1.21%, and firmness of 9.06–35.72 N. There were significant differences among genotypes for all of these attributes. A-663 CN (0.86 abs) had higher chlorophyll than Souvenirs (0.32 abs). Effie (264.00 g) was larger than A-663 CN (132.00 g) and A-794 CN (135.33 g). A-885 (12.17%) had higher soluble solids than A-819 (7.23%). A-819, A-885, Amoore Sweet, and Souvenirs had higher pH than A-663 CN, A-794 CN, A-811 CN Bowden, and Bradley. A-794 CN (1.21%) had a higher titratable acidity than Souvenirs (0.47%). Souvenirs (35.72 N) and A-794 CN (32.67 N) were firmer than A-819 (9.06 N).

The attributes of the tree-ripened fruit and the commercially ripened fruit varied at harvest. In general, commercially ripened fruit had higher chlorophyll, titratable acidity, and firmness than tree-ripened fruit (Fig. 1). However, tree-ripened fruit had slightly higher

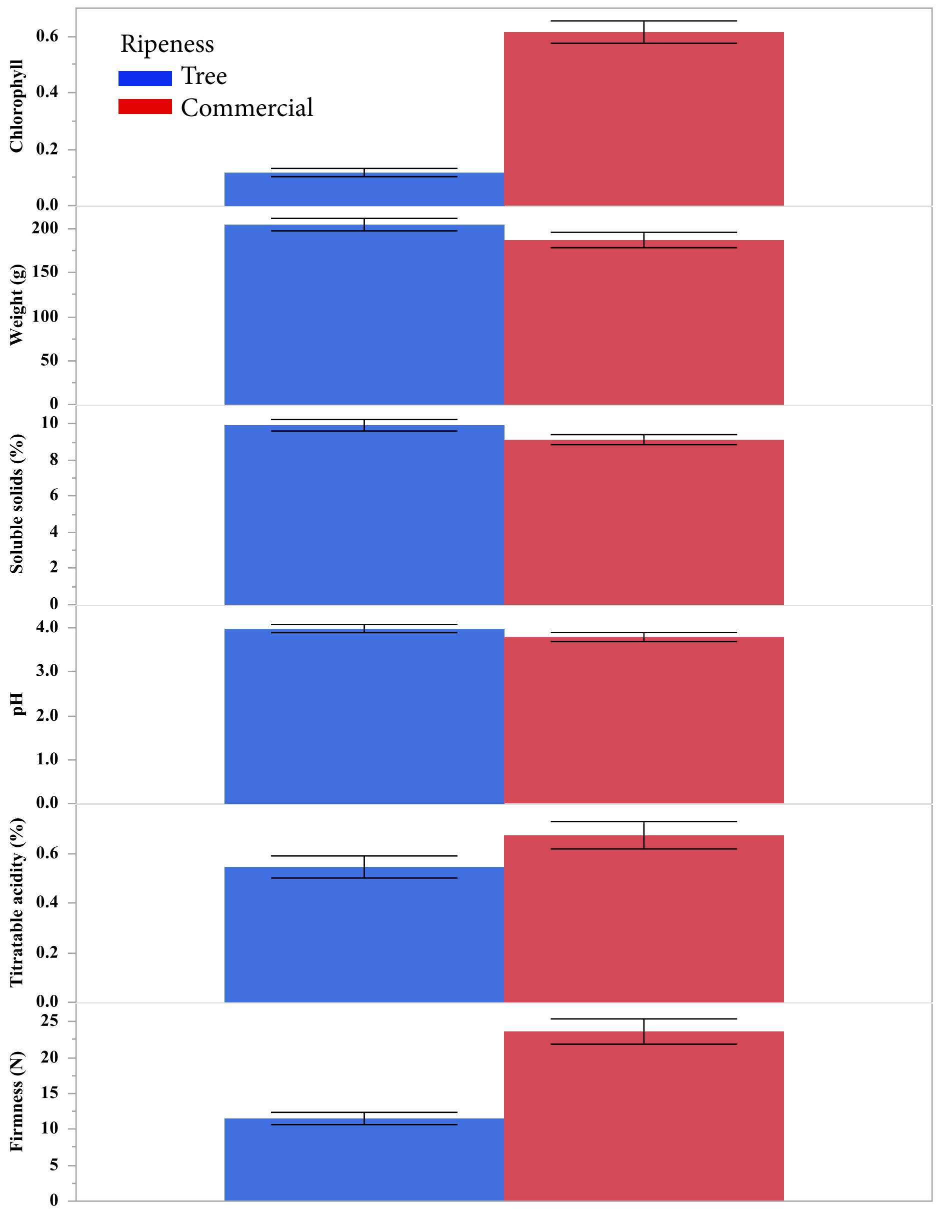

Fig. 1. Physiochemical attributes of tree-ripened and commercially ripened fresh-market peach and nectarine genotypes at harvest (day 0), University of Arkansas System Division of Agriculture's Fruit Research Station, Clarksville, AR (2017). Each standard error bar is constructed using 1 standard error from the mean.

fruit weight, soluble solids, and pH than commercially ripened fruit. Zhang et al. (2017) showed high correlations between firmness and chlorophyll of peaches. A similar study on California free stone peaches concluded increased maturity of peaches at harvest (tree-ripened peaches) are characterized by decreasing flesh firmness and titratable acidity, as well as increasing soluble solids (Rood, 1957).

Physiochemical Attributes of Commercially Ripened Fruit During Storage

The physiochemical attributes of the commercially ripened fruit were evaluated during storage. The storage × genotype interaction was not significant for chlorophyll, fruit weight, soluble solids, pH, and titratable acidity, but was significant for firmness (Table 3 and Fig. 2). During storage, chlorophyll and fruit weight significantly decreased, while soluble solids increased (Table 3). There were no significant changes in pH or titratable acidity during storage. The average pH and titratable acidity during storage was 3.86 and 0.66%, respectively. When compared to fruit from day 14, fruit from day 0 had higher chlorophyll (0.62 abs) and fruit weight (187.40 g). Soluble solids were significantly lower at day 0 (9.13%) compared to days 7 and 14, 10.54% and 11.08%, respectively. Cirilli et al. (2016) found that once a peach or nectarine was picked, the sugar content did not increase significantly, but the acidity decreases as the peach ripens due to enzyme metabolism.

During storage, genotypes differed significantly. A-663 CN and Bradley (0.75 abs) had the higher chlorophyll than A-885 (0.35 abs) and Souvenir (0.37 abs). For fruit weight, Effie (203.11 g) was larger than A-794 CN (120.00 g). A-794 CN had a lower pH than A-819

Table 3. Main and interaction effects for physiochemical attributes of commercially ripened fresh-market peach and nectarine genotypes stored at 4 °C for 0, 7, and 14 days, University of Arkansas System Division of Agriculture's Fruit Research Station, Clarksville, Arkansas (2017).

Storage	Chlorophyll (abs)	Fruit weight (g)	Soluble solids (%)	pH	Titratable acidity† (%)
0 days	0.62 a‡	187.40 a	9.13 b	3.79 a	0.68 a
7 days	0.60 a	163.53 b	10.54 a	3.91 a	0.66 a
14 days	0.50 b	150.83 b	11.08 a	3.89 a	0.63 a
P-value	<0.0062	<0.0001	<0.0001	*0.1722*	*0.1990*
Genotype					
A-663 CN	0.75 a	138.67 bc	9.12 bcd	3.55 def	0.79 cd
A-794 CN	0.46 bcd	120.00 c	11.96 a	3.21 f	1.25 a
A-811 CN	0.44 cd	178.11 ab	9.63 bcd	3.41 ef	0.93 bc
A-819	0.63 abc	175.00 ab	8.22 d	4.60 a	0.43 f
A-885	0.35 d	162.44 abc	11.41 ab	4.58 a	0.21 g
Amoore Sweet	0.65 abc	180.56 ab	10.47 abcd	4.40 ab	0.51 ef
Bowden	0.68 ab	181.89 ab	10.91 abc	3.27 ef	0.97 b
Bradley	0.75 a	171.56 ab	8.66 cd	3.62 de	0.67 de
Effie	0.64 abc	203.11 a	12.02 a	3.83 cd	0.37 fg
Souvenirs	0.37 d	161.22 abc	10.08 abcd	4.16 bc	0.42 f
P-value	*<0.0001*	<0.0001	*<0.0001*	*<0.0001*	*<0.0001*
Storage x Genotype (P-value)	*0.2035*	*0.3353*	*0.2019*	*0.4939*	*0.4688*

† Calculated as percent malic acid.

‡ Genotypes were evaluated in triplicate (n = 3). Means with different letter(s) for each attribute within effects are significantly different ($P < 0.05$) using Tukey's honestly significant difference test.

and A-885. Effie (12.02%) and A-794 CN (11.96%) had higher soluble solids than A-819 (8.22%). A-885 (0.21%) had a lower titratable acidity than A-794 CN (1.25%).

The storage × genotype interaction was significant for firmness, but data for firmness were lost for Amoore Sweet and A-885 at day 14 of storage. Among most of the genotypes, there was a general trend for firmness to increase from day 0 to day 7, but then decrease from day 7 to day 14 (Fig. 2). This softening behavior, with an initial stage of an increase in firmness, followed by a rapid loss of firmness was also shown when assessing blueberry softening (Paniagua et al., 2013). There was a correlation between firming of blueberries during storage with very low moisture loss. Souvenirs had the highest firmness at day 0, but the lowest at day 14, and the firmness decreased during storage. Clark and Sandefur (2013b) indicated that Souvenirs, a slow-melting-flesh peach, had excellent postharvest storage potential. A-819 had the lowest firmness on day 0, but firmness increased during storage. At day 14, A-663 CN, a non-melting nectarine, had the highest firmness.

Regardless of genotype, there was a decrease in chlorophyll and weight loss, and an increase in soluble solids during storage, but there was not much change in pH and titratable acidity (Fig. 3). There was also lower flesh firmness at day 14 when compared to day 0.

Conclusions

Understanding the postharvest physiology of the 10 peach and nectarine genotypes evaluated from the University of Arkansas System Division of Agriculture's Fruit Breeding Program has identified possible maturity indices for each genotype. The data revealed high variability in ripeness parameters between the genotypes evaluated, indicating that genotype was the most important factor for determining postharvest quality and extended shelf-life. However, picking fruit to ripen during storage does impact the ripeness attributes when compared to picking fruit at tree ripeness.

The attributes of the tree-ripened fruit and the commercially ripened fruit varied at harvest with commercially ripened fruit having higher chlorophyll, titratable acidity, and firmness than tree-ripened fruit. However, tree-ripened fruit had slightly higher fruit weight, soluble solids, and pH than commercially ripened fruit. For the

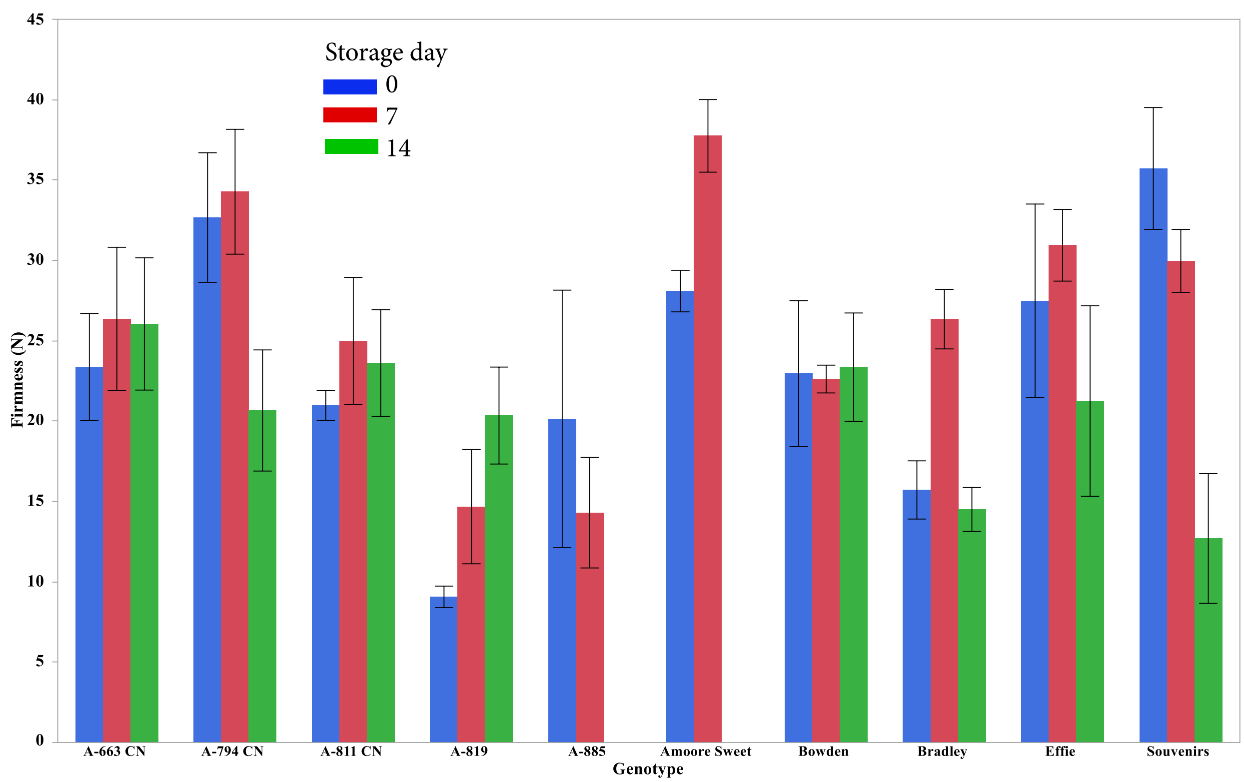

Fig. 2. Firmness of commercially ripened fresh-market peach and nectarine genotypes during storage at 0, 7, and 14 days at 4 °C, University of Arkansas System Division of Agriculture's Fruit Research Station, Clarksville, Arkansas (2017). Each standard error bar is constructed using 1 standard error from the mean. Data is missing for Amoore Sweet and A-885 at 14 days of storage.

tree-ripened fruit at harvest, A-811 CN was the largest fruit, A-794 CN had the highest soluble solids and titratable acidity, Souvenirs had the lowest firmness, and Amoore Sweet was the firmest.

During storage of the commercially ripened fruit, there was a decrease in chlorophyll and weight loss and an increase in soluble solids, but there was not much change in pH and titratable acidity. During storage, A-885 had the lowest chlorophyll, Effie was the largest and had the highest soluble solids, and A-794 CN had the lowest fruit weight, lowest pH, and highest titratable acidity. The titratable acidity and soluble solids reached the potential of tree-ripened fruit after 7 days of storage. However, some ripeness attributes of the commercially ripened fruit,

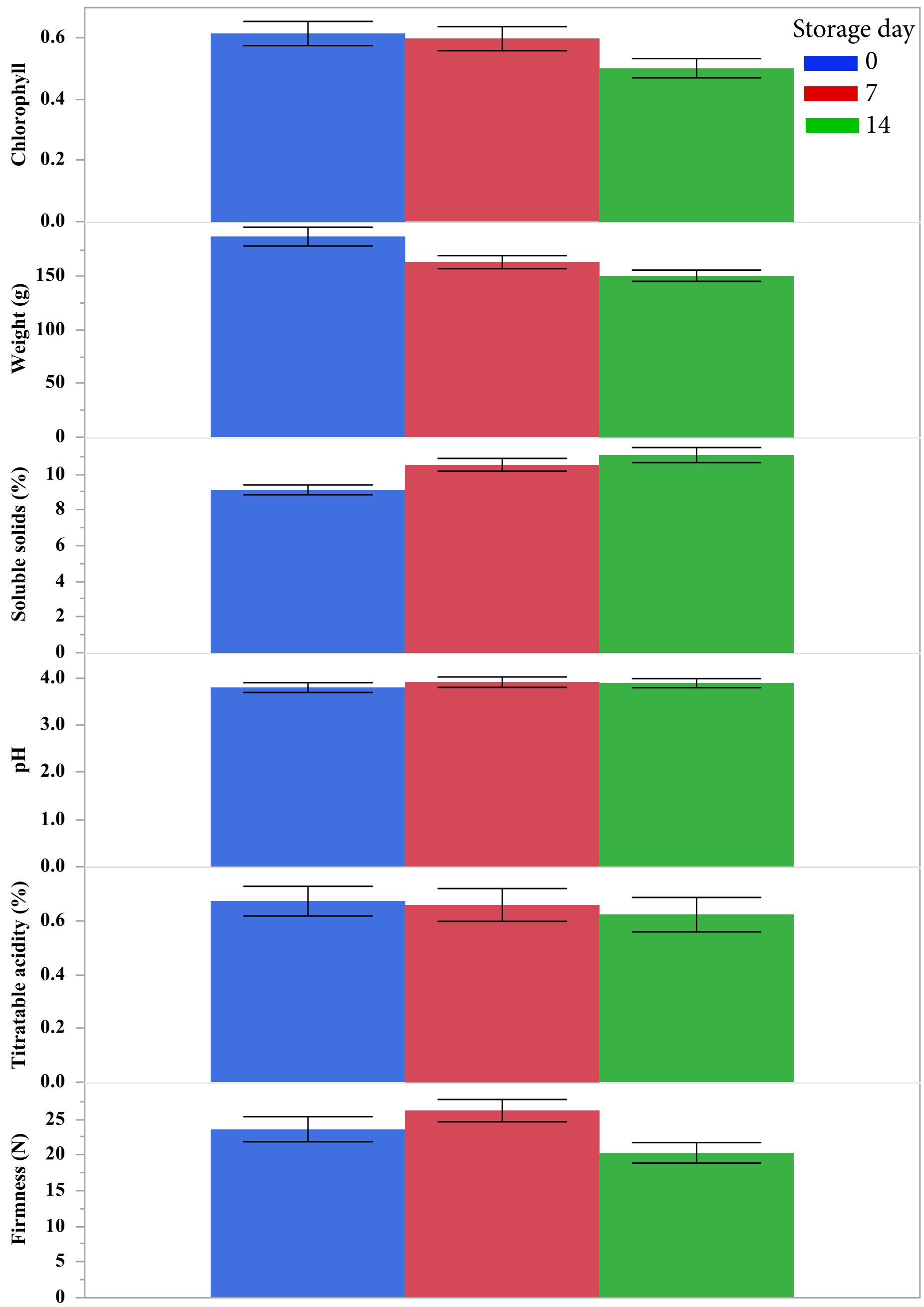

Fig. 3. Physiochemical attributes of commercially ripened fresh-market peach and nectarine genotypes during storage at 0, 7, and 14 d at 4 °C, University of Arkansas System Division of Agriculture's Fruit Research Station, Clarksville, Arkansas (2017). Each standard error bar is constructed using 1 standard error from the mean.

such as chlorophyll and fruit weight, were not achieved as compared to the tree-ripened fruit. The firmness of the commercially ripened fruit at harvest increased from day 0 to day 7, but decreased from day 7 to day 14. Some of the genotypes evaluated performed well regardless of if the fruit was picked to ripen during storage or picked ripe from the tree. The ripeness attributes evaluated will help to determine the optimal harvest time, handling, and storage conditions of peach and nectarines for growers in Arkansas and other regions. This research will provide insight on the potential for releasing new peach and nectarine cultivars from the University of Arkansas System Division of Agriculture's breeding program.

Acknowledgements

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