

Report

Title: Assessing the Postharvest Quality and Sensory Attributes of Four Blackberry Cultivars Grown in South Georgia

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Public Abstract:

Consumer preferences are based on different aspects of blackberry fruit quality, such as appearance, firmness, flavor, and nutritional value. Even though consumers prefer blemishless fruit, repeat purchases depend on fruit flavor. In our sensory evaluations, consumers preferred ‘Caddo’ among the four cultivars and ‘Ouachita’ was the least preferred. ‘Caddo’ was scored highest on overall appearance and overall flavor throughout the three harvests. ‘Caddo’ was the largest of the four cultivars and exhibited the least amount of RDR. Some of the current prominent compounds across all cultivars are Hexanal, Butanoic Acid, 2-Hexenal, 2-Hexen-1-ol, 1- Pentanol, 4-methyl-, 2-Heptanol, Camphene, Hexanoic acid, O-Cymene, D-Limonene, linalool, Nonanal, and Octanoic acid.

Introduction

Blackberry production and consumption have increased in the United States over the past decade. Similarly, blackberry production acreage in Georgia has increased from 300 acres in 2009 to 818 acres in 2017 (USDA-NASSA,2021). Blackberries are harvested in Georgia from June to mid-July, and the main producing area in the state is South Georgia. Arkansas-bred cultivars are mainly grown in South Georgia. However, no information on fruit quality characteristics of Arkansas cultivars grown under Georgia conditions was previously reported. Fruit quality and sensory characteristic was only reported under Arkansas weather conditions (Threlfall et al., 2022). Environmental factors affect a plant’s biochemical and physiological process, consequently affecting fruit quality (Baldwin, 2002). Furthermore, geographic location, climate, the type of soil and cultural practices influence physicochemical and sensory attributes (Di Vittori et al., 2018). Even though, South Georgia and Arkansas have a humid subtropical climate; the two locations differ in the minimum and maximum temperatures, as well as precipitation patterns; during fruit development and harvest season. The average temperature in Arkansas (from the central to the south of the state) during June fluctuates from ~79.8°F to 78.2°F, while in South Georgia fluctuates from 81.9°F to 80.6°F. Furthermore, precipitation patterns also differ from May to July in both states, with Arkansas having an average of 3.62 inches and Georgia 4.61 inches (Climate.org, accessed October, 2022). Indeed, differences in

weather pattern during fruit development and harvest season can affect fruit quality attributes (Stafne et al., 2017), and may also affect sensory characteristics and volatile profile and consequently impact consumer preferences. Consumer preferences are based on different aspects of blackberry fruit quality, such as appearance, firmness, flavor, and nutritional value (Threlfall et al., 2019). However, even though consumers prefer blemishless fruit, repeat purchases depend on fruit flavor. Flavor does not only include taste but also several other sensations that humans perceive while eating (Klee and Tieman, 2018). Generally, the sugar/acid ratio in the fruit is not solely what determines consumer preferences. A diverse group of chemical compounds, such as amino acids, aroma volatiles, and phenolic compounds, influence consumer preference. In this project, we plan to evaluate the physicochemical and sensory attributes of four Arkansas-bred cultivars: Ouachita, Caddo, Ponca and Osage, grown in South Georgia.

Objectives

- 1) Evaluate physicochemical and sensory attributes of four blackberry cultivars grown in South Georgia.
- 2) Identify key volatile aroma compounds of four blackberry cultivars grown in South Georgia.

Materials and Methods

In the first year of this study (Summer 2023), four cultivars were hand harvested (Ouachita, Caddo, Ponca and Osage) from a commercial farm located in Irwin county, GA. All the cultivars were managed equally. Blackberries were field packed and transported to UGA-Tifton Campus and stored overnight at 34°F (1°C) at 90-95% R.H. The blackberries were hand-sorted to remove any damaged or diseased berries before storage. Physicochemical attributes were analyzed at four different stages: immediately after harvest (initial evaluation), 7 days of storage, 14 days of storage, and 21 days of storage. Three sensory panels were conducted a day after harvest using a non-trained panel. Volatile collection/sample preparation were analyzed 24 hours after harvest. Additionally, volatiles collection/sample preparation occurred after every seventh day of storage. Quality characteristics that were measured include berry weight, firmness, total soluble solids, titratable acidity, red drupelet reversion (RDR) presence, respiration rate, and volatile compound content.

Results:

Consumer preferred ‘Caddo’ among the four cultivars with and ‘Ouachita’ was the least preferred. Caddo scaled highly on overall appearance and overall flavor throughout each harvest (Table 1 to 4). Caddo was the largest of the four cultivars and exhibited the least amount of RDR both initially and after storage (Table 5 to 7). Titratable acidity (TA) and total soluble solid (TSS) samples are currently in the process of being completed alongside anthocyanin, the raw data collected will be analyzed using R-Studio and JMP Statistical software. However, we are partially presenting the results of TA and TSS (8-9).

Aroma volatile samples are currently being analyzed using a Gas chromatography system paired with Mass Spectrometry. Samples are expected to be completed before the next upcoming

blackberry harvest season in 2024. The methodology requires finetuning as the number of identify volatiles for each cultivar is lower than previous literature states. Some of the current prominent compounds across all cultivars are Hexanal, Butanoic Acid, 2-Hexenal, 2-Hexen-1-ol, 1- Pentanol, 4-methyl-, 2-Heptanol, Camphene, Hexanoic acid, O-Cymene, D-Limonene, linalool, Nonanal, and Octanoic acid. All listed volatile compounds are above a 75% purity percentage.

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Table 1. Sensory attributes of four blackberry cultivars evaluated using a 9-point hedonic scale. 1= dislike extremely, 9= like extremely, 5= neither like nor dislike. Means with different letters for each attribute are significantly different ($P \leq 0.05$) using Tukey's significant different test. Harvest Date: June 8th, 2023

Sensory Evaluation I							
Cultivar	Overall Appearance	Overall Flavor	Color	Firmness	Size/Shape	Sourness	Sweetness
Caddo	8.4 a	7 a	8.4 a	8 a	8.6 a	5.6 a	6.8 a
Ouachita	6.9 b	5.1 b	7.5 a	7 a	6.6 c	4.7 a	4.8 b
Osage	7.6 ab	6.7 a	8 a	7.2 a	7.7 ab	5.2 a	6.2 a
Ponca	7.2 b	6.7 a	7.9 a	7.2 a	6.7 bc	5.6 a	6.1 ab
P Value	0.0004	0.0006	0.0959	0.1223	0.0000009	0.2947	0.0020

Table 2. Sensory attributes of four blackberry cultivars evaluated using a 9-point hedonic scale. 1= dislike extremely, 9= like extremely, 5= neither like nor dislike. Means with different letters for each attribute are significantly different ($P \leq 0.05$) using Tukey's significant different test. Harvest Date: June 14th, 2023

Sensory Evaluation II							
Cultivar	Overall Appearance	Overall Flavor	Color	Firmness	Size/Shape	Sourness	Sweetness
Caddo	8.2 a	6.9 a	8.3 a	7.6 a	8 a	5.4 a	6.8 a
Ouachita	7.8 ab	6.5 a	8.4 a	7.5 a	7.5 a	5 a	5.8 a
Osage	7 b	6.2 a	7.6 a	7 a	6.6 a	5.5 a	6.5 a
Ponca	7.6 b	6.9 a	8 a	7.4 a	7.5 a	5.2 a	6.7 a
P Value	0.1268	0.6157	0.2254	0.6471	0.0793	0.9385	0.3283

Table 3. Sensory attributes of four blackberry cultivars evaluated using a 9-point hedonic scale. 1= dislike extremely, 9= like extremely, 5= neither like nor dislike. Means with different letters for each attribute are significantly different ($P \leq 0.05$) using Tukey's significant different test. Harvest Date: June 22nd, 2023

Sensory Evaluation III							
Cultivar	Overall Appearance	Overall Flavor	Color	Firmness	Size/Shape	Sourness	Sweetness
Caddo	7.3 ab	6.7 ab	7.7 a	6.9 a	7 b	5.6 a	6.3 ab
Ouachita	6.9 b	5.7 b	7.8 a	7 a	6.9 b	5.3 a	5.2 b
Osage	8 a	7.2 a	8.1 a	7.7 a	8.2 a	6.2 a	6.8 a
Ponca	7.6 ab	6.2 ab	7.9 a	6.9 a	7 b	5.7 a	5.9 ab
P Value	0.0639	0.0072	0.6154	0.2370	0.0104	0.5141	0.0358

Table 4. Percentage of red drupelet reversion (RDR) presence in Ouachita blackberries over three harvest dates. The statistical difference comparing RDR presence initially after harvest and after 21 days of storage. Means with different letters for each harvest are significantly different ($P \leq 0.05$) using Tukey's significant difference test.

RDR Presence Ouachita		
Harvest #	Day 0	Day 21
Harvest 1	87 % a	78 % a
Harvest 2	97 % a	40 % b
Harvest 3	87 % a	48 % b
P Value	0.1094	0.00003

Table 5. Percentage of red drupelet reversion (RDR) presence in Osage blackberries over three harvest dates. The statistical difference comparing RDR presence initially after harvest and after 21 days of storage. Means with different letters for each harvest are significantly different ($P \leq 0.05$) using Tukey's significant difference test.

RDR Presence Osage		
Harvest #	Day 0	Day 21
Harvest 1	32 % a	60 % ab
Harvest 2	52 % a	68 % a
Harvest 3	32 % a	42 % b
P Value	0.0336	0.0101

Table 6. Percentage of red drupelet reversion (RDR) presence in Ponca blackberries over three harvest dates. The statistical difference comparing RDR presence initially after harvest and after 21 days of storage. Means with different letters for each harvest are significantly different ($P \leq 0.05$) using Tukey's significant difference test.

RDR Presence Ponca		
Harvest #	Day 0	Day 21
Harvest 1	57 % a	43 % b
Harvest 2	57 % a	75 % a
Harvest 3	57 % a	52 % b
P Value	0.2497	0.0007

Table 7. Percentage of red drupelet reversion (RDR) presence in Caddo blackberries over three harvest dates. The statistical difference comparing RDR presence initially after harvest and after 21 days of storage. Means with different letters for each harvest are significantly different ($P \leq 0.05$) using Tukey's significant difference test.

RDR Presence Caddo		
Harvest #	Day 0	Day 21
Harvest 1	35 % a	55 % b
Harvest 2	38 % a	78 % a
Harvest 3	35 % a	57 % b
P Value	0.9095	0.0121

Table 8. Compositional attributes titratable acidity and total soluble solids in ‘Caddo’ blackberries harvested on three separate dates and stored for 21 days. The statistical difference comparing the TA or TSS over 21 days of storage for each harvest date. Means with different letters for each measurement day are significantly different ($P \leq 0.05$) using Tukey’s significant difference test.

Compositional Attributes ‘Caddo’						
Harvest #	Harvest 1		Harvest 2		Harvest 3	
Days after Storage	TA	TSS	TA	TSS	TA	TSS
0	0.237 b	9.567 a	0.276 b	9.933 a	0.281 b	8.833 a
7	2.459 a	7.333 a	2.338 a	9 a	2.459 a	8.667 a
14	2.46 a	7.833 a	2.241 a	7.967 a	2.085 a	7.567 a
21	2.261 a	8.767 a	2.338 a	7.267 a	2.213 a	7.133 a
P Value	0.000094	0.6240	0.0000043	0.3790	0.0000099	0.6515

Table 9. Compositional attributes titratable acidity and total soluble solids in ‘Ponca’ blackberries harvested on three separate dates and stored for 21 days. The statistical difference comparing the TA or TSS over 21 days of storage for each harvest date. Means with different letters for each measurement day are significantly different ($P \leq 0.05$) using Tukey’s significant difference test.

Compositional Attributes ‘Ponca’						
Harvest #	Harvest 1		Harvest 2		Harvest 3	
Days after Storage	TA	TSS	TA	TSS	TA	TSS
0	2.302 a	8.63 a	2.523 a	7.567 a	2.224 b	9.3 a
7	2.486 a	8.3 a	2.308 a	7.033 a	2.839 a	7.87 a
14	2.411 a	6.03 a	2.488 a	6.767 a	2.578 ab	7.8 a
21	2.49 a	7.1 a	2.535 a	7.433 a	2.176 b	7.13 a
P Value	0.7115	0.1294	0.7673	0.7568	0.0214	0.3661