

Title of Project: Evaluating Sugar, Acid, and Antioxidant Profiles of Northern Highbush, Southern Highbush, and Rabbiteye Blueberry Fruit Over Postharvest Storage

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Public Abstract:

In Georgia, the commercial blueberry industry consists of two types of blueberries: southern highbush and rabbiteye. There is a subjective debate among the blueberry industry regarding the fruit quality of the two types, and often, rabbiteye are perceived to have a lesser fruit quality. A third commercial blueberry type, northern highbush, composes the largest part of the US market but it not suited for southern climates. Northern highbush are frequently considered to have the highest fruit quality, yet the research on the fruit quality of the three blueberry types and their quality attributes over fresh postharvest storage (4°C) is limited at best. The main objective of this work is to examine the chemical fruit quality parameters of sugars, acids and antioxidants during fresh postharvest storage (4°C) for major rabbiteye, southern highbush, and northern highbush cultivars. Eighteen and 15 cultivars were collected over the three blueberry types in 2018 and 2019, respectively, and were collected from Georgia, Michigan, Indiana, and Canada from May-August. Fruit from both southern highbush and rabbiteye were collected from commercial packing sheds from approximately May to July of each season. Fruit from northern highbush cultivars came from commercial packers and were transported to Georgia via refrigerated truck from July to September of each season, and fruit were collected in a similar manner to southern highbush and rabbiteye cultivars. All fruit were packed in coolers and transported to the UGA Griffin campus for testing. Fresh fruit from all cultivars were frozen at -15°C after being stored at four time points: 1) fruit kept at 4° C for 3 days, 2) fruit kept at 4° C for 10 days, 3) fruit kept at 4° C for 20 days, and 4) fruit kept at 4° C for 30 days. Fruit are being tested for individual sugar, acid, and antioxidant profiling. These

results will be compared with the initial physical and chemical fruit quality measures collected on fresh fruit to gain a better understanding of the overall fruit quality of the three blueberry types. This will allow industry members to have a better knowledge of fruit quality of Georgia blueberries, and how these cultivars compare to additional cultivars that compose the larger blueberry market as a whole.

Objectives:

The main objective of this proposal is to evaluate sugar, acid, and antioxidant profiles of the major commercial cultivars of northern highbush, southern highbush, and rabbiteye blueberry from fruit collected throughout fresh postharvest storage at 4°C. This would provide growers and marketers with fruit quality cultivar specific parameters over one month in fresh postharvest storage. The profiles of sugars, acids, and antioxidants examined in each cultivar will be used to further understand how these attributes maintain/lose quality over time in storage, and be used to help further understand their relations to additional physical and chemical instrumental fruit quality traits in their relation to overall shelf life. The information gathered in this study will strengthen and complement a completed study that is no longer funded which examined fruit skin strength, fruit firmness, berry weight, percent healthy fruit, soluble solid content, total titratable acid content, and anthocyanin content evaluated over four timepoints in fresh postharvest storage over two years. The additional work proposed in this study presented here will provide the industry with another layer of important information on the fruit quality characteristics of the cultivars within the three blueberry types.

Justification:

In Georgia, the blueberry industry consists of two types of blueberries: southern highbush and rabbiteye. Of the total state blueberry acreage produced in Georgia, southern highbush and rabbiteye compose approximately 60% and 40%, with both blueberry types being an important part of the state's blueberry industry. There are significant economic benefits to growers having both types of blueberries in their farm. The southern highbush cultivars ripen earlier than rabbiteye cultivars, which provide the grower with higher prices often associated with early fruit, and extends the state's blueberry season. However, the earlier fruit ripening is preceded by earlier flowering which can be susceptible to late spring frosts often causing significant yield losses. Rabbiteye cultivars are firm fruit, typically more suitable for mechanical harvesting than are southern highbush. Machine harvesting can be accomplished for approximately one seventh the price of the hand harvesting typically done with southern highbush cultivars. Having cultivars of both blueberry types is the most economically viable option for the blueberry industry in Georgia and in the Southeast. However, there is much subjective discussion among those in the blueberry industry regarding the fruit quality of the two types. Often, rabbiteye are perceived to have a lesser fruit quality than southern highbush, yet the limited amount of research examining fruit quality differences between the two blueberry types is inconclusive at best. Similarly, approximately 75% of the North American blueberry market consists of a third commercial type of blueberry, northern highbush, which is adapted to colder climates and is unable to grow successfully in Georgia. Subjective biases comparing fruit quality of the two blueberry types grown in Georgia and the northern highbush type exist. More objective information needs to be gathered on the fruit quality of the major cultivars within the three main commercial types to gain a better understanding of the actual fruit quality differences and similarities present among and within the three blueberry types. The main objective of this

proposal is to provide growers and marketers with fruit quality cultivar specific parameters during fresh postharvest storage for major rabbiteye, southern highbush, and northern highbush cultivars.

In 2018, 18 cultivars were collected and evaluated over the three blueberry types from Georgia, Michigan, and Canada from May-August. Cultivars collected included: eight southern highbush cultivars, five rabbiteye cultivars, and five northern highbush cultivars. In 2019, 17 cultivars were collected and evaluated over the three blueberry types from Georgia, Michigan, and Indiana from May-August. Cultivars collected included: seven southern highbush cultivars, five rabbiteye cultivars, and five northern highbush cultivars. Fresh fruit from all cultivars were examined over four time points (TP): 1) fruit kept at 4° C for 3 days, 2) fruit kept at 4° C for 10 days, 3) fruit kept at 4° C for 20 days, and 4) fruit kept at 4° C for 30 days. Fruit were tested using instrumental analyses of fruit quality for physical (fruit skin strength, fruit firmness, berry weight, and percent healthy fruit) and chemical (soluble solid content, total titratable acid content, and anthocyanin content) fruit quality traits. However, fruit were not evaluated for more detailed chemical traits profiling individual sugars, acids, and antioxidants. Understanding these would enhance the industry's understanding of how these cultivars maintain or lose quality over time in storage, and may help to understand if any of these traits may help to predict or further understand postharvest shelf life.

Overall, this project is important in helping Georgia maintain and potentially increase their overall share in the blueberry market. Understanding the overall fruit quality attributes of the southern highbush and rabbiteye blueberries will allow producers and retailers have a better knowledge of fruit quality of Georgia blueberries and how these cultivars compare to additional cultivars that compose the larger blueberry market as a whole. In addition, growers and retailers will be able to identify unique cultivars that have better postharvest keeping qualities throughout longer shelf-life for shipping or marketing. This information can help the growers and producers to enhance, and to prevent lowered, sale price-point of Georgia grown blueberry cultivars. The information provided by this study should also help blueberry producers target specific markets depending on their postharvest capabilities and of their quality parameters.

Methodologies:

Blueberry cultivars collected represent an array of fruit ripening times throughout the season (early, middle and late season ripening) for the best representation of the whole Georgia blueberry market, in addition to the northern highbush blueberry market. In 2018, 18 cultivars were collected and evaluated over the three blueberry types from Georgia, Michigan, and Canada from May-August. Cultivars collected included: eight southern highbush cultivars including 'Camellia', 'Farthing', 'Keecrisp', 'Legacy' from GA, 'Legacy' from MI, 'Meadowlark', 'Suziblue', and 'Star'; five rabbiteye cultivars including 'Alapaha', 'Austin', 'Brightwell', 'Powderblue', and 'Vernon'; and five northern highbush cultivars including 'Bluecrop', 'Draper', 'Elliott', 'Liberty', and 'Nelson'. In 2019, 15 cultivars were collected and evaluated over the three blueberry types from Georgia, Michigan, and Indiana from May-August. Cultivars collected included: seven southern highbush cultivars including 'Star', 'Abundance', 'Farthing', 'Suziblue', 'Legacy'(both from GA and MI), and 'Camellia'; and five rabbiteye cultivars including 'Alapaha', 'Brightwell', 'Powderblue', 'Vernon', and 'Premier'; and three northern highbush cultivars including 'Aurora', 'Elliott', and 'Liberty'. Fruit from both southern highbush and rabbiteye were collected from commercial packing sheds from approximately May to July of each season. Fruit from northern highbush cultivars came from commercial packers

and were transported to Georgia via refrigerated truck. Fruit were collected in a similar manner to southern highbush and rabbiteye cultivars from July to September of each season. Fruit were picked up from commercial packers, packed in coolers and transported to the UGA Griffin campus for fruit quality testing. Fresh fruit from all cultivars were examined for the aforementioned physical and chemical fruit quality traits over four time points (TP): 1) fruit kept at 4° C for 3 days, 2) fruit kept at 4° C for 10 days, 3) fruit kept at 4° C for 20 days, and 4) fruit kept at 4° C for 30 days.

Additionally, fruit were frozen at each timepoint at -15°C and held until juice processing. Three replications of fresh blueberries per cultivar were weighed (60.00 to 61.00 g) and stored in freezer-safe Ziploc bags at $-15 \pm 1^\circ\text{C}$ in a walk-in freezer. Fruit were thawed at $21 \pm 1^\circ\text{C}$ for approximately one hour. Samples were weighed (55.00 to 56.00 g) and pureed for approximately one minute using a Ninja Ultima™ Blender BL810 30 series (Balance Inc., Cleveland, OH) until samples were homogenized. Three replications per cultivar were weighed (40.00 to 41.00 g) and poured into 50 mL oak ridge Nalgene centrifuge tubes (Thermos Scientific, Waltham, MA). Samples were centrifuged (Eppendorf, 5810R, Enfield, CT), for 20 minutes at 12,100 rpm and 5°C. Supernatant was filtered through a pre-cut, four-layered cheesecloth in two 15 mL VWR® SuperClear™ Ultra High Performance Centrifuge Tubes (Radnor, PA). Juice extracts are currently stored at $-15 \pm 1^\circ\text{C}$ for sugar, acid, and antioxidant profiling analyses.

Results and Progress to date:

Due to the large number of potential samples due to number of cultivars collected over two years with four timepoints/cultivar/year, cultivars were initially selected for profiling based on presence in the cultivar list for both years. Cultivars selected that were collected during both seasons were six southern highbush cultivars ‘Camellia’, ‘Farthing’, ‘Legacy’ from GA, ‘Legacy’ from MI, ‘Suziblue’, and ‘Star’; four rabbiteye cultivars ‘Alapaha’, ‘Austin’, ‘Brightwell’, ‘Powderblue’, and ‘Vernon’; and two northern highbush cultivars ‘Elliott’ and ‘Liberty’. In addition, time points initially selected for evaluation were the initial timepoint (fruit kept at 4° C for 3 days after collection and then frozen) and the final timepoint (fruit kept at 4° C for 30 days after collection and then frozen). During the grant period, HPLC protocols for sugar, acid and antioxidant profiling were examined and optimized for analyzing blueberry fruit samples. Additionally, a PhD student who is working on a portion of the project was trained on HPLC protocols so that samples can be run in both Dr. Itle’s lab and in Dr. Deltsidis’ lab, and that protocols used will be consistent across labs. After this point, the main person working on this project, Dr. Loayza, left UGA to pursue other professional endeavors. Recently, a new scientist has been hired in Dr. Deltsidis’ lab, so the project will continue again with processing samples. Due to the change in personnel and the shipping delays experienced in project supplies, there are no results for the project to-date as the project has been temporarily delayed. It is anticipated that the project will be completed within the next calendar year.