A new approach to evaluating the impact of supply chain conditions on blueberry quality and waste

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Introduction

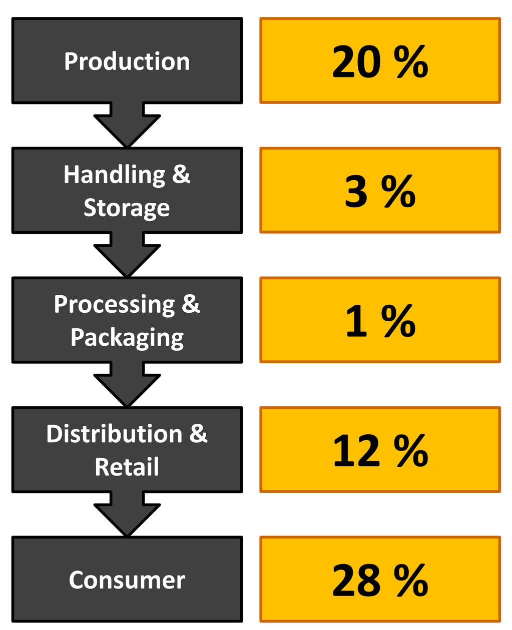


Fig. 1. Fruit and vegetable waste at each step of the supply chain. [1,2]

Fresh fruits and vegetables are amongst the most frequently wasted foods because of their high perishability and postharvest handling requirements also because often their appearance quality is overemphasized.

- It is well established that waste begins at the farm and accumulates throughout the supply chain (Fig. 1). [1, 2]
- For ***blueberry***, reported waste values at the retail and consumer levels are approximately 5 and 12%, respectively. [3, 4]
- However, there is a lack of information regarding the level of impact of each step along the ***supply chain*** on blueberry quality, and on how to prioritize actions along the supply chain to achieve an immediate and effective impact on ***waste*** reduction.

The ***objectives*** of this study were to determine the impact level of each step along the supply chain on blueberry quality, and to identify critical supply chain steps where the decline in quality was highest.

Material & Methods

Plant material and experimental setup. 'Jewel' blueberries were harvested twice (≈28 kg, each harvest), randomly selected for uniformity of color and freedom from defects. Four replicate samples of 150 g of fruit per treatment (control plus 18 supply chain conditions) were carefully distributed to three clamshells. The clamshells containing the fruit for initial, both non-destructive and destructive quality evaluations were then stored for specific periods of time inside temperature and humidity-controlled chambers (Forma Environmental Chambers Model 3940 Series, Thermo Electron Corporation, OH, USA) set at temperatures between 1.0 and 30.0 ± 0.3 °C and 80 to 90 % RH.

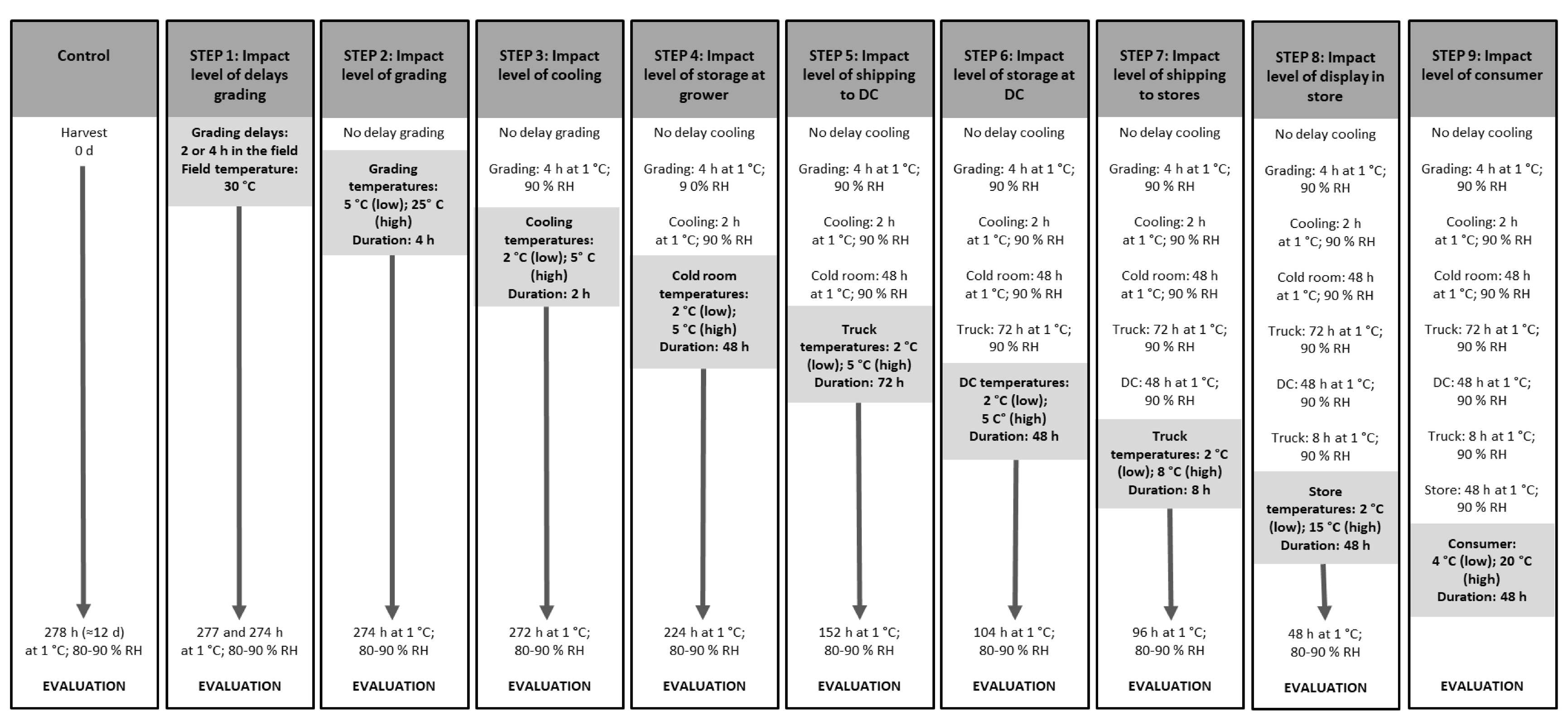


Fig. 2. Blueberry supply chain simulations from the field (step 1) to the consumer (step 9). Each section represents a supply chain step and within each step a best and worst time-temperature scenario were tested. (DC) distribution center.

Quality of the fruit was evaluated, at each step individually, after a total supply chain length of 278 h (≈ 12 d). Simulated supply chain conditions within each step were selected based on estimated time-temperature profiles observed during blueberry handling. [5, 6, 7, 8] For each supply chain simulation, only one step differed from the control, and before and after each o f those different time-temperature treatments, the strawberries were kept at constant optimum conditions (i.e., 1 °C and 80-90 % RH) (Fig. 2).

Quality evaluation. Blueberries were evaluated at harvest (initial) and the end of each supply chain step (178 h) for subjective quality evaluation, [9, 10, 11] instrumental color and texture, weight loss, acidity, SSC, total phenolics and anthocyanins, sugars and ascorbic acid contents. [12]

Results

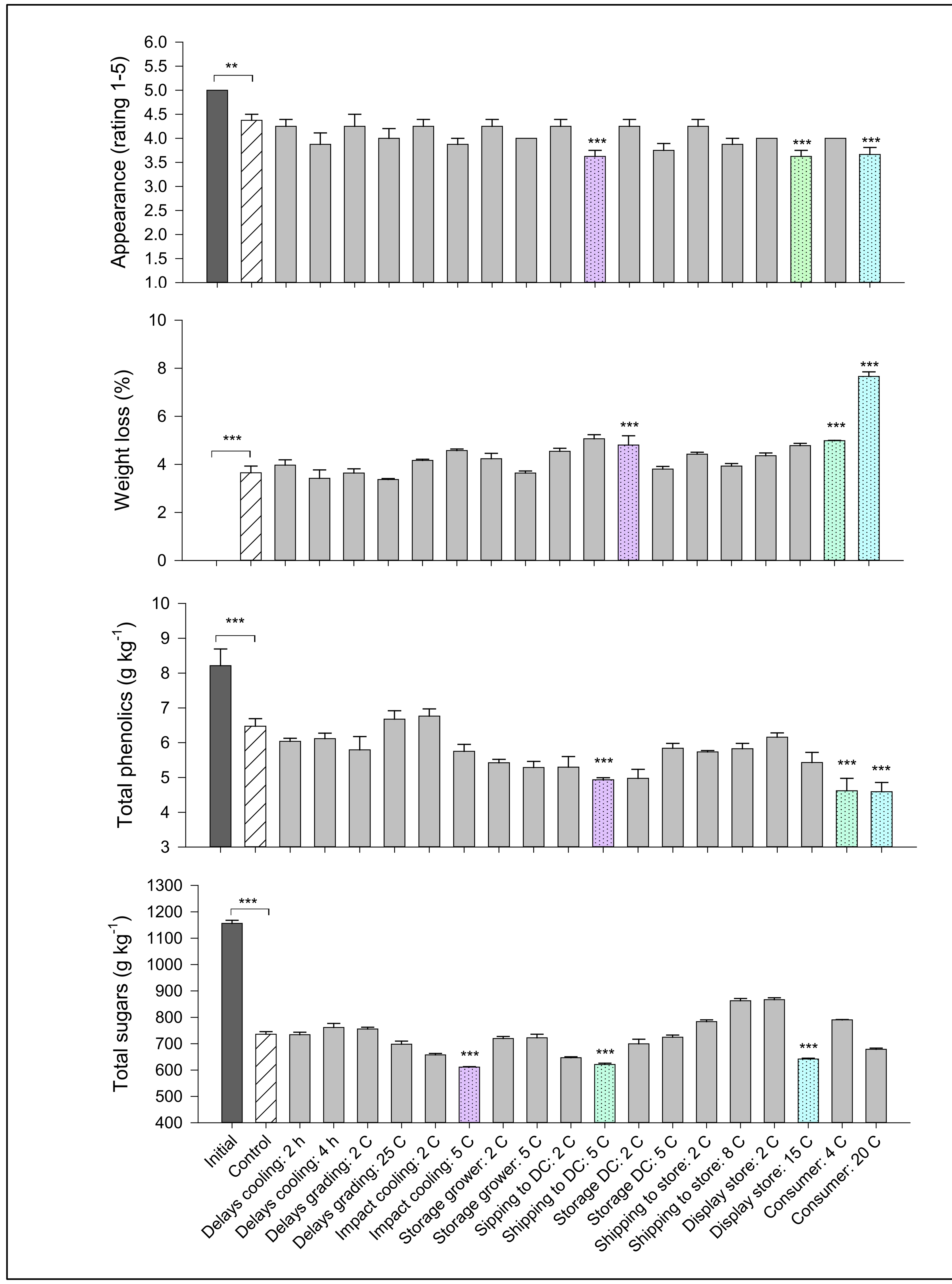


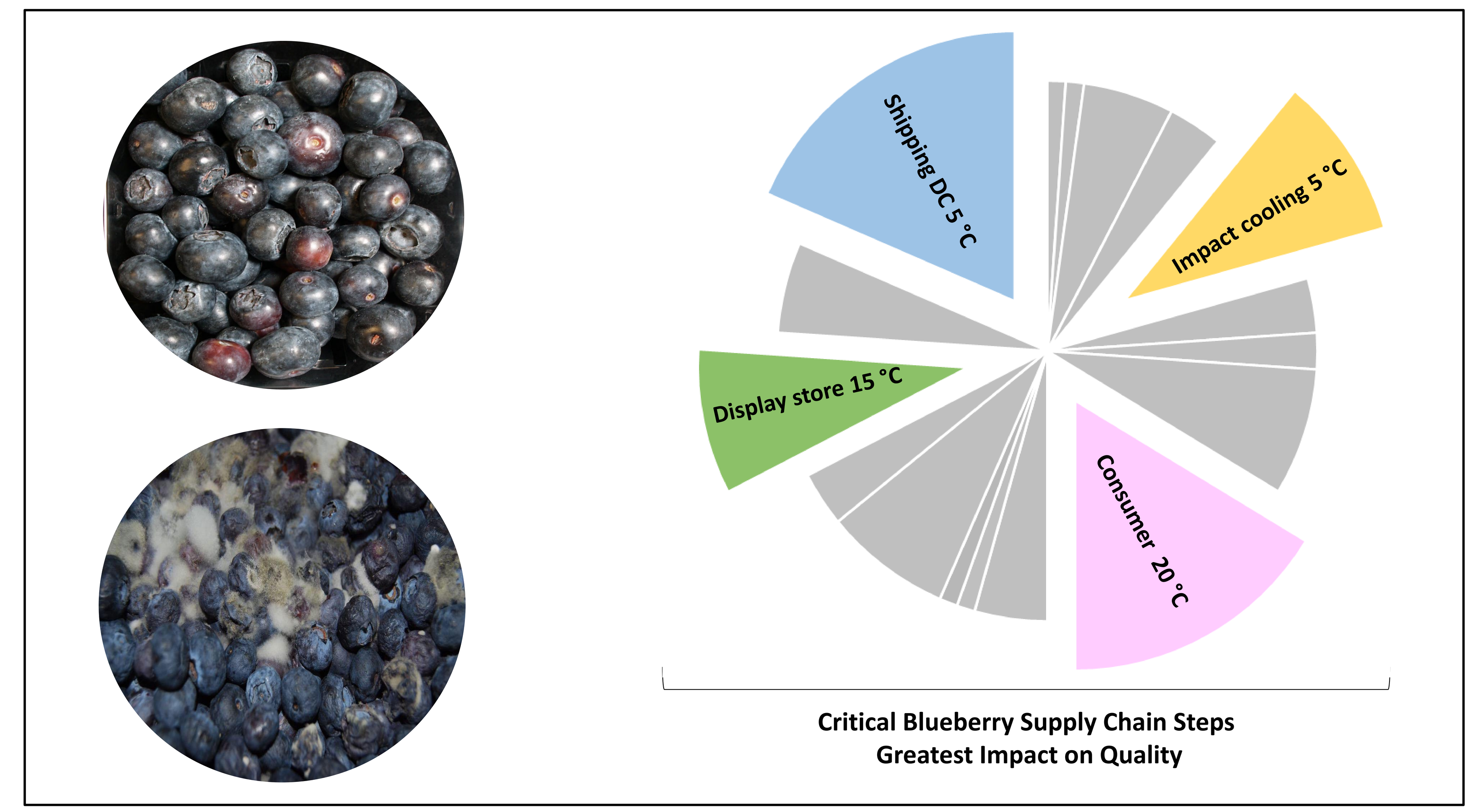
Fig. 3. Impact level of each step along the supply chain on blueberry appearance, weight loss, total phenolics and total sugars. Bars are means ± SE of 3 biological replicates of 150 g of blueberries each. Asterisks indicate significant differences between initial quality at harvest and control (constant temperature at 1 °C) and between the control and the three critical steps along the supply chain with the highest decline in each attribute (** p ≤0.001; ***p≤ 0.0001). *NOTE: Only data for the second harvest and selected quality attributes are shown.*

Conclusions

Results from this study clearly show that maintaining a constant optimum temperature throughout the supply chain is paramount to reducing blueberry quality losses and consequently waste. Overall, steps with the greatest impact on overall strawberry quality and thus considered critical supply chains steps were:

- ***Impact cooling at 5 °C (9.8%)***
- ***Shipping to the distribution center at 5 °C (16.3%)***
- ***Display in the store at 15 °C (8.7%)***
- ***Storage at the consumer level at 20 °C (18.5%)***

These results can have a significant impact on the blueberry industry because by targeting critical points along the supply chain where (and why) quality is consistently lost, new approaches and recommendations can be developed to help target the points where actions with the greatest impact can be implemented using good handling practices throughout the supply chain and ultimately reduce produce waste.



Acknowledgements

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