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

Anastasia Ktenioudaki1,2, Katrina Kelly1 and Maria Cecilia do Nascimento Nunes1
1Food Quality Laboratory, Department of Cell Biology, Microbiology & Molecular Biology, University of South Florida FL 33620, USA
2University College Dublin, School of Biosystems & Food Engineering, Belfield, Dublin 4, Ireland

Introduction

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 [1, 2]. 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 prioritise 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.

Results

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. For each supply chain simulation, only one step differed from the control, and before and after each of these different time-temperature treatments, the strawberries were kept at constant optimum conditions (i.e., 1 °C and 80 to 90 % RH).

Material & Methods

Plant material and experimental setup. ‘Jewel’ blueberries were harvested twice ( ≈ 12 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 steps) were carefully distributed to three clamshells. The clamshells containing the fruit for initial, both transport, and final quality evaluations were distributed to the following conditions: (1) 5 °C (10 h); (2) 7 °C (12 h); (3) 9 °C (20 h); (4) 23 °C (16 h); (5) 25 °C (14 h); (6) 27 °C (12 h). Simulated supply chain conditions within each step were selected on the basis of estimated time-temperature conditions observed during blueberry handling [5, 6, 7]. For each supply chain simulation, only one step differed from the control, and before and after each of these different time-temperature treatments, the strawberries were kept at constant optimum conditions (i.e., 1 °C and 80 to 90 % RH) (Fig. 2). Quality evaluation. Blueberries were evaluated at harvest (initial) and the end of each supply chain step (187 h) for subjective quality evaluation.

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 chain steps were:

- Impact cooling at 5 °C (8.9%)
- Shipping to the distribution center at 5 °C (16.1%)
- Storage at the consumer level at 20 °C (18.1%)

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 highlight 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

This work was supported by the Specialty Crop Block Grant Program at the U.S. Department of Agriculture (USDA) and the European Union’s Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No 70837.

References