Title Traceability of environmental conditions for maintaining horticultural produce quality

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Abstract

Purpose of review: The purpose of this review is to present various monitoring systems that have been used recently or have the potential to trace environmental conditions surrounding perishable foods from the field to retail.

Findings: Numerous monitoring systems are commercially available to trace the temperature and some environmental conditions surrounding perishable foods in the supply chain. These measured parameters can be recorded with different systems in each segment of the supply chain. To obtain a complete history of the conditions surrounding a particular lot of fresh produce from field to retail display, one would need to obtain the histories recorded while the lot was in each segment of the supply chain. Although this type of pedigree will indicate whether or not a lot of fresh produce has been exposed to adverse conditions, it does not necessarily represent the temperature, the atmosphere composition or other condition of the produce itself. Systems that monitor the produce environment from field to retail can be integrated in the inventory management systems used by produce shippers, wholesalers and retailers. Portable data loggers are becoming smaller and more economical every year. When placed inside a unit of fresh produce (container, pallet, box, bag , etc.), loggers could record produce environmental conditions from packing right up to when the content of the unit is stacked in the retail display. Remote monitoring systems allow shippers to verify the condition of a lot of produce in transit, which is extremely useful for long-duration shipments. To effectively use these environmental condition histories, models need to be developed to predict the shelf-life remaining when a particular produce is exposed to specific conditions. Several researchers have tested various systems to determine their accuracy in predicting remaining shelf-life, however very few researchers have carried out this testing for fresh whole or fresh-cut produce. For example, radio frequency identification (RFID) labels that record temperatures are the ultimate traceability tool as they will be able to reconstruct the history of a produce from packing to retail display. However, the RFID labels need to have data on the time-temperature tolerance of each type of produce they must

follow to be able to accurately indicate the change in microbial or sensory qualities of fresh produce that have occurred. Regardless of the type of traceability tool used (portable data logger, time-temperature integrators, RFID label, etc.), external condition tolerance data is required for all type of fruits and vegetables to optimise inventory management.

Limitations/implications: Although traceability of temperature already exists, only a few real commercial applications of tracing other environmental conditions exist. Thus, this review could not be limited to existing cases only. Scientific literature and industrial applications have been searched to highlight potential equipment used by horticulture and other industries, or through research activities and that could be used for monitoring and reporting all environmental conditions. Various companies manufacture systems that could be used to trace environmental conditions however, they may not have published articles on their systems. Therefore their system could not be reported here. This review is limited to what is available in the literature at the present time. Other systems might exist. The absence or the presence of any system should not be considered as a negative or positive comment about these systems.

Directions for future research: Enough knowledge is already available to design traceability systems for monitoring and reporting some environmental conditions of horticultural produce. However, although some technologies exist, it is clear that their full potential is not exploited nor explored. Many technologies could be applied to traceability systems for monitoring and reporting horticultural produce environmental conditions with little adaptation. Development of new types of affordable and precise sensors that could record environmental conditions for long periods and make this data available at any time is highly desirable. More research is required in this domain, but we are not starting at the very beginning so care should be taken to not reinvent procedures that are already available. Standardisation is also an important issue. Since traceability should be from the seed to the table, the compatibility between database and communication systems should be discussed on a national, if not international, basis. Individual companies should not decide to monitor and record their data based only on their own needs. Research, development and standardisation must be based on world need considerations. Great challenges exist for all those wanting to participate in the development of systems that trace the environmental conditions of horticultural produce, from the seed to the table.