Dynamic Fruit Needs Dynamic Storage

Let the product be your guide

By Anna Mouton

Frank van de Geijn is a senior consultant and post-harvest researcher at Wageningen University and Research. He is with the Agrotechnology and Food Sciences Group which focusses on all questions relating to post-harvest: processing, packing, energy, and fruit quality.

"Optimal storage and dynamic storage have the same goals," said Van de Geijn, "extended storage time, improved quality, reduction of specific disorders, and control of quality development not only during storage but especially in the shelf-life period. Product response control is a way to create not ready-to-eat but ready-to-enjoy."

According to Van de Geijn, the idea of fixed storage conditions is outdated. Storage operators should be guided by the signals that their fruit produces. Fruit responds to storage conditions by changes in respiration rate — measurable as consumption of oxygen and production of carbon dioxide and heat. Response can also be monitored through moisture and mass loss, quality development, and biomarkers such as chlorophyll fluorescence and ethanol production.

Lowering oxygen concentrations depresses respiration and reduces quality loss of fruit during storage. Dynamic response control systems aim to establish the lowest oxygen levels at which fruit will still respire aerobically. Van de Geijn explained that the optimum oxygen concentration is that which also minimises carbon dioxide production. Once oxygen levels fall below this level, the fruit will switch to fermentation.

WHAT SYSTEMS ARE AVAILABLE?

Commercial dynamic control systems assess fruit responses by measuring respiration rate, ethanol production, skin chlorophyll fluorescence, or a combination of these. Ethanol was the original marker. Storage operators can send samples for ethanol determination to a laboratory or even test the fruit themselves. They will then manually adjust the oxygen set point depending on the ethanol levels.

Systems that automate ethanol testing are available. Van de Geijn used the example of Storex dynamic control systems where a special box containing a representative sample of fruit and an analyser is used to monitor rooms. The analyser measures ethanol as well as oxygen and carbon dioxide.

The HarvestWatch system relies on measuring chlorophyll fluorescence as a proxy for oxygen levels. "Does it have a direct link to fermentation?" asked Van de Geijn. "I'm still waiting for a good publication on that." The Fruit Observer system from the Besseling Group also relies on chlorophyll fluorescence.

The dynamic control system from Van Amerongen is based on measuring the respiratory quotient — the ratio of carbon dioxide produced to oxygen consumed — of the fruit. An elevated respiratory quotient is an indication of fermentation and ethanol synthesis.

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BEST PRACTICES FOR DYNAMIC CONTROL SYSTEMS

"I think this type of close-to-the-limit technology should be applied to product that's valuable," said Van de Geijn. He advises caution when using dynamic control on new cultivars and colour mutants as these may respond in unexpected ways.

Van de Geijn's suggestion is to start with conventional controlled atmosphere conditioning and then drop the oxygen in increments of 0.2% per week for oxygen levels above 0.7%, or increments of 0.1% per week for oxygen levels below 0.7%. "The moment we go below 0.1% oxygen, we start tasting the product and checking quality in general."

Fruit held at lower oxygen levels may be more sensitive to carbon dioxide disorders. Van Geijn recommends reducing carbon dioxide to below the levels usually advised. In most cases where ethanol develops the fruit can be recovered, although this is difficult when fermentation occurs in the first month of storage.

Van Geijn reminded the audience that a gas-tight storage room is essential. To maintain oxygen levels below 0.1%, the effective leakage area should be less than 0.1 square centimetre per 100 cubic metre room.

THE BOTTOM LINE

So what system is the best? Van de Geijn doesn't have a specific recommendation but he gave some pointers. "I think there's a huge difference between suppliers in service and especially in the first year you should ask for guidance. Be aware that some systems provide more than just a signal — they provide information about the batch or the room behaviour, especially the respiration rate.

"All dynamically controlled atmosphere systems focus on lowering oxygen levels safely. I think the critical factor is the uniformity of the batches in a room and that has nothing to do with the system itself. Our advice is, it's okay that you replace your common sense by technology, but please stay in charge and check, in a basic way, your fruit." **FQ**

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