PF18002: PASSIONFRUIT POST HARVEST BEST PRACTICE REVIEW

BY JENNY EKMAN, AHR

PASSIONFRUIT AND ETHYLENE

Project PF18002 is currently reviewing postharvest best practice for passionfruit.

There are a number of commercial products available which claim to improve fruit storage life by removing ethylene gas. These include ethylene absorbing sachets, ethylene scavenging plastic films and ethylene scrubbing devices. However, before buying the latest anti-ethylene technology, it's probably useful to understand the relationship between passionfruit and ethylene.

PASSIONFRUIT RIPENING

Like mangos, papaya, and bananas, passionfruit are a climacteric fruit. That is, they go through a distinct ripening process, during which colour develops, acids decrease, and the fruit becomes sweet and ready to eat (Figure 1 SEE PAGE 19).This is accompanied by significant increase in respiration rate and a burst of ethylene production.

As passionfruit are ripening on the vine they produce high, but not extreme, amounts of ethylene (30–50 µl/kg/h). However, once they detach ethylene production shifts into top gear, increasing many times over. It can reach as high as 1,000 µl/kg/hour (Figure 2 SEE PAGE 19). This massive burst of activity makes passionfruit one of the highest ethylene emitters of any fruit.

Ethylene stimulates detachment from the vine. It is possible that detached fruit lying on the ground are stimulating nearby fruit to also detach. Several researchers have noted that some passionfruit detach prematurely, possibly through this mechanism.

Ethylene can shorten the shelf life of many fruit, vegetables and cut flowers. For example, as little as 0.1 parts per million (ppm) ethylene can reduce storage life of strawberries, cause flowers to shed their petals, turn carrots bitter, and trigger ripening of kiwifruit.

To put this in perspective, a single 5kg carton of warm passionfruit placed in a 500m^3 cool room would generate 0.1ppm within 10 hours, or less if the room was full of other products. There is clearly a LOT of ethylene to soak up if you are dealing with passionfruit!

METHODS OF REDUCING ETHYLENE

POTASSIUM PERMANGANATE

To date, the most common method of eliminating ethylene has been to react it with potassium permanganate ($KMnO_4$). The $KMnO_4$ is usually coated onto porous beads of vermiculite, clay, silica or – more recently – zeolite particles. These increase the effective surface area, improving the reaction between molecules of ethylene and the $KMnO_4$, as well as potentially absorbing some ethylene on the carrier itself. The reaction oxidises the bright purple $KMnO_4$ into brown manganese oxide (MnO_2). You can see that some of the beads shown in Figure 3 are already turning brown.

Figure 3. Potassium permanganate coated beads

Potassium permanganate is used in many different commercial ethylene scavengers, ranging from small sachets that can be put into a carton, to large filters installed over the cold room vents and even printed labels and pads for packaging. All of these products can be limited by lack of air circulation. For example, getting all the air inside a room to pass over or through a filter requires a very high rate of air movement. Moreover, if high rates of ethylene are being produced, then filters can really struggle to keep up. They also need to be checked regularly to make sure plenty of the $KMnO_4$ is still purple ie. not yet oxidised to brown.

Inside a small carton, there may be even less air circulation. One trial found that even adding 50g $KMnO_4$ (+ zeolite) per kilo of ripening tomatoes barely halved the ethylene concentration around the fruit. For comparison, the tomatoes were producing around 20µl/kg/hour ethylene – only 2% as much as passionfruit!

PALLADIUM

More recent work has focussed on a palladium-based material. This has much greater affinity for ethylene than $KMnO_4$. One gram of palladium (+ zeolite) can scavenge an incredible 45,000µl (45ml) ethylene under dry conditions. Although absorbance is reduced to 4,000µl at 100% RH, the material has been demonstrated to completely remove ethylene from some storage environments. Unfortunately, it is not easy to find any commercial products using this technology, possibly due to cost.

OZONE

Another way of eliminating ethylene involves the use of ozone. Ozone (O^3) is extremely reactive. It reacts with any organic molecule, including fungal spores, bacteria, ethylene, cardboard cartons, rubber door seals, parts of your refrigeration equipment, the passionfruit and your eyes, skin and lungs.

For this reason, ethylene removal systems usually enclose the ozone inside a treatment unit. The cool room air is drawn through the unit, eliminating the ethylene. Again, treating the total volume of cool room air as fast as the fruit are producing ethylene can be an issue.

New systems are now available which release low levels of ozone directly into the cold room air. These are fitted ozone detectors which adjust release, keeping room levels below those that can damage equipment or, importantly, human health.

The system can be run at slightly higher levels overnight while the room is closed. Ozone generation is reduced in the morning before workers arrive. Lockout alarms are installed to ensure such systems are safe to use.

Naturally ozone-based systems are expensive – but could be well worth the investment for storage of very ethylene sensitive produce, such as kiwifruit or cut flowers.

WHAT ABOUT PASSIONFRUIT?

Ethylene scavenging / removing systems can slow down ripening of tropical fruit such as papaya, mangoes and bananas. Around one 20g sachet is likely to be needed per 300g to 500g fruit

However, passionfruit are already ripe when they are packed. Moreover, they are producing huge quantities of ethylene, so reducing concentrations around the fruit to levels where they don't affect storage life is always going to be challenging. This is further complicated by the passionfruit structure; their relatively thick skin means that ethylene levels are likely to be higher inside the fruit than the surrounding air.

I have not found any research providing evidence that reducing ethylene in the storage environment improves passionfruit storage life. This doesn't mean it can't, but it seems unlikely.

In summary, when it comes to ethylene, try before you buy!

Jenny Ekman
E: jenny.ekman@ahr.com.au
M: 0407 384 285

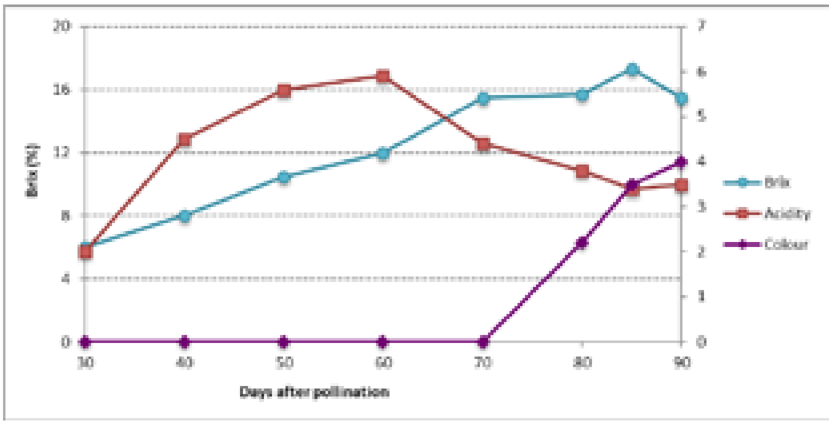

Figure 1. Changes in % Brix, Titratable acidity (TA, measured as citric acid) and purple colour development of passionfruit during maturation on the vine. Data derived from Shiomi et al, 1996.

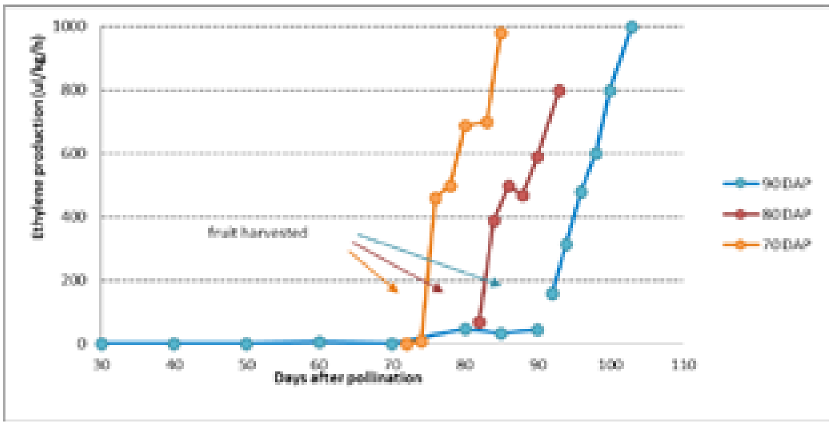

Figure 2. Ethylene production of fruit while attached to the vine, then during storage at 25°C following harvest at either 70, 80 or 90 days after pollination (DAP). Data derived from Shiomi et al, 1996.

Hort Innovation
Strategic levy investment
PASSIONFRUIT FUND

PF18002 has been funded by Hort Innovation, using the passionfruit research and development levy and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.