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10. Post Harvest treatments

Post Harvest treatments are used either to maintain fruit quality or to prevent storage disorders from developing.

The most common use is diphenylamine (DPA) to prevent apples from developing superficial scald. Apples that are most susceptible are Granny Smith, Braeburn and the Red apple varieties. DPA is either applied by shower-type drive-through drenches, or by transporting bins on a conveyer system through a dip tank. DPA concentrations vary from 500 to 2500 parts per million (ppm), depending on the variety and risk of scald. It is important to keep the EU maximum residue level (MRL) of 5 mg/kg (ppm) in mind, although this varies between markets (see www.dfpt.co.za), when administering DPA. DPA is broken down during storage. Thus fruit that is destined for short-term storage can be treated with lower concentrations (depending on maturity), and fruit destined for long-term storage should receive higher concentration treatments. If fruit is treated with a high DPA concentration and stored for a short-term, the MRL might be exceeded.

Other treatments are dipping with chlorine to disinfect fruit. Chlorine concentration should be checked regularly as it is a volatile substance and also binds to organic particles in the water. The recommended chlorine concentration is between 75 and 100 ppm (35,7g/1000l water) at water pH of 6,5 to 7,0, although chlorine can be stable down to a pH of 5. Sodium or calcium hypochlorite dissociates in water to form hypochlorous acid, also known as a 'free chlorine', which is the primary biocidal agent responsible for killing micro-organisms. Water pH outside the above range has a profound effect on the concentration of the available free chlorine (<http://postharvest.tfrec.wsu.edu/PC2004B.pdf>).

In South Africa, certain quaternary ammonium compound (QAC) sanitisers and chlorine dioxide sanitisers have been evaluated with improved inoculum reduction, compared to chlorine, on different substrate surfaces, including wood, and are recommended as sanitisers above chlorine. These sanitisers are non-corrosive on all surfaces, unlike chlorine, which is corrosive on metal surfaces. Sanitisers recommended in South Africa include, Terminator, Sporekill, DSC 1000, all QAC sanitisers and Oxine, a chlorine dioxide sanitiser (1). Chlorine dioxide works relatively independent of pH as it oxidises, as opposed to chlorinating, organic molecules.

Ozone (text courtesy of OLGEAR) can also be used as a sanitiser. Ozone is highly reactive and unstable form of oxygen where three oxygen molecules are temporarily bonded. Ozone cannot be stored and is generated electrically on-site from air where and when needed. Ozone has potent antimicrobial abilities.

Ozone Applications in Air

Adding ozone to air in packhouses and storage rooms can control post-harvest diseases on fruit, retard the production of spores from decaying fruit, sanitise surfaces and destroy ethylene. Ozone typically does not reduce infection of inoculated wounds, but it can slow down enlargement of the infection. Penetration of ozone into packaged or covered fruit is greatly reduced. Sanitising effects in packages with large vents or open topped bins is good. Superficial scald is not controlled by ozone, but development is reduced. No differences in the physiological properties between treated and untreated fruit are detected at typical concentration levels. Sanitation of equipment and fruit surfaces with ozone gas is possible but doses of ozone that kill post-harvest pathogenic fungi in a few hours or days are very high so the use of lower concentrations over extended periods is advised.

Ozone in Water

Ozone in water is an organic alternative to many of the conventional chemical sanitisers. Ozone decomposes quickly to oxygen and leaves no residue and few disinfection by-products. It has the ability to break down chemicals such as pesticide residues as well. Ozone is considerably stronger and faster in its rate of reaction than many common disinfectants. Packing line process water can be sanitised through the use of ozone. Generally speaking pathogens accumulate quickly in tank water where fresh fruit are cleaned. This can lead to decay in storage, shipping, or marketing. Disinfection of this water is therefore important. The surface of fruit can also be sanitised with ozonated water. Ozone in water to control pathogens inoculated into wounds on fruit has however not been effective in controlling infections from wounds inoculated before ozone treatment.

Ozone Safety

Ozone at high levels is toxic and workers must be protected from it. The exposure limit in workplaces for ozone gas, on a time-weighted average, during an eight-hour workday is 0.1 ppm. The ability to determine ozone concentrations in air on-site is highly recommended.

Fungicides can be used in conjunction with DPA, typically on Red apples and pears which are prone to core rot and other fungal infections. Check regularly for the allowance of these chemicals as the list of permissible chemicals and their MRL's changes regularly (see www.dfpt.co.za).

If the pack house has the facility, pears should preferably be handled dry and not through the water flume system.

Flume water can be chlorinated with 75 to 100 ppm chlorine. Since the chlorine concentration decreases by evaporation and reacting with organic material, it needs to be replaced on the basis of regular concentration tests. Be aware that chlorine is corrosive and might attack unprotected metal parts.

Other post harvest treatments are aimed at preventing bitter pit (Golden Delicious, Braeburn). Fruit can be dipped in a calcium chloride (anhydric, 98% food grade) solution. For specific mixing instructions, refer to the manufacturer's label instructions. In some instances the calcium chloride and DPA treatments can be combined. There is always a risk of incompatibility and coagulation, which might result in chemical burn on the fruit, especially where fruit is touching the bin floor or water droplets which form between fruit.

SmartFresh (text courtesy of AgroFresh) is commonly used for both RA and CA storage to maintain eating quality during shelf-life. Treatment must take place within seven days of harvest. Best results are obtained when starch conversion is less than 40%, provided the fruit has reached its climacteric peak. Specific guidelines per cultivar are available from the supplier.

SmartFresh has a further benefit in that it controls superficial scald and eliminates the need for a chlorine drench prior to storage. The risk of core rot in Red Delicious types and other varieties, due to infection through wide calyx cavities, is thus reduced.