

Minimising the risk of microbial contamination of fresh produce

There are many microorganisms (microbes) in the environment – some are harmless, some are beneficial, and others cause food spoilage and breakdown. A small number of microbes have the potential to cause food poisoning. These microbes are called human pathogens. Examples of human pathogens include species of bacteria such as *E.coli*, *Salmonella* and *Listeria*, parasites such as *Cryptosporidium* and *Giardia* and viruses such as Hepatitis A.

Contamination of fresh produce with human pathogens can present a serious health risk, particularly to susceptible consumers such as old, young and sick people. To prevent this from happening:

- the risk of human pathogens contaminating fresh produce must be assessed;
- good agricultural practices must be implemented in the growing and harvesting of fresh produce;
- hygiene and sanitation practices must be implemented in the packingshed in the handling and preparation of fresh produce for market; and
- all practices must be regularly monitored and reviewed periodically or as practices change.

Sources of human pathogens

From planting through to transport to customers, there are many opportunities for human pathogens to contaminate fresh produce. Potential sources of contamination include:

- soil and dust
- organic products used as fertilisers and soil additives
- water used for irrigation, spraying, water dumps, hydrocooling, top-icing, washing and postharvest treatments
- workers who handle fresh produce at harvest and during grading and packing
- wild and domestic animals, birds and vermin
- harvest bins and containers and harvest and packing line equipment
- packing containers and materials
- storage facilities and transport vehicles

Preventing human pathogens from contaminating fresh produce during growing, harvesting, packing, storing and transport to customers is the best way to minimise the risk to consumer health.

Good agricultural practices during growing and harvesting of fresh produce

Practices that minimise the risk of fresh produce being contaminated with human pathogens during growing and harvesting include:

- ✓ Locate or cover stockpiles of organic products (for example animal manure) to avoid contamination from wind drift onto adjacent crops and harvested produce or rainfall runoff into watercourses and groundwater.
- ✓ Use growing practices that minimise the chance of human pathogens from untreated organic products coming into direct contact with fresh produce. For example, quickly incorporate untreated animal manure into the soil to minimise contamination of adjacent crops from wind drift or contamination of water supplies by rainfall runoff into watercourses and groundwater, and grow the fresh produce on plastic mulch.
- ✓ Maximise the period between applications of untreated organic product and when the crop is harvested – ensure a minimum of 60 days between application and harvest.
- ✓ Compost or age organic products to reduce microbe levels. Composting is more effective than aging. Longer treatment periods are required for aging (usually at least six months) than composting (about six weeks). Handle products produced by vermiculture in the same way as other untreated organic products as there is no heating to reduce microbe levels during production.
- ✓ For side dressing, only use treated proprietary organic products or composted manure containing less than 100 *E.coli* per gram. Ask the supplier (manufacturer) for evidence that the product has been treated and does not exceed this critical limit.
- ✓ Do not apply composted manure or proprietary organic products over the top of produce.
- ✓ Minimise the potential risk of faecal contamination from the presence of livestock, birds and other animals. For example, grazing animals are not allowed into growing crops or adjacent areas during the last 60 days before harvesting.
- ✓ Assess water used for irrigation and spraying for risk of contaminating fresh produce. Where a significant risk exists, either treat the water with a sanitiser or use an alternative water source. The risk of microbial contamination is higher if irrigation water comes into direct contact with the fresh produce immediately before harvest.

- ✓ Check harvest containers and equipment for soundness and cleanliness before use and clean or discard them as required.
- ✓ Train workers about sources of microbial contamination and the importance of good hygiene practices.

Hygiene and sanitation practices during washing, treatment and packing of fresh produce

Practices that minimise the risk of fresh produce being contaminated with human pathogens after harvest include:

- ✓ Assess all water used in the packing shed for risk of contaminating produce, such as water used for water dumps, washing, hydrocoolers, top-icing, postharvest treatment, cleaning of packing line equipment and surrounding areas and water used for staff facilities.
- ✓ Select water sources or sanitise water used for postharvest treatments and for hand washing to minimise the risk of contamination of produce.
- ✓ Treat water dumps and hydrocooler solutions with an approved sanitiser to maintain water quality for the duration of use. Monitor the concentration of sanitiser to ensure levels are maintained and keep a record of the initial sanitiser concentration, monitoring frequency, monitoring results, water condition relative to maintaining sanitiser effectiveness (pH, temperature) and quantities of supplementary sanitiser added.
- ✓ Replace water dump, hydrocooler and postharvest treatment solutions at appropriate intervals and do not allow water and treatment solutions to stagnate between uses.
- ✓ Heat water dumps to 5°C above fruit temperature to avoid infiltration of microbes through the stem end.
- ✓ Train workers about contamination sources and the importance of maintaining packing shed sanitation practices and personal hygiene requirements.
- ✓ Provide toilets and hand washing facilities that are equipped and maintained to enable workers to achieve personal hygiene requirements. Position signs in visible places to reinforce personal hygiene requirements and monitor workers for their compliance with the requirements.
- ✓ Develop and follow a cleaning plan that ensures that the cleanliness of packing shed areas and facilities is maintained. Use vermin control measures to minimise infestations, discourage birds from roosting and exclude domestic animals from all areas where fresh produce is handled, packed and stored.
- ✓ Check packing containers and equipment, storage areas and transport vehicles before use for cleanliness and vermin infestation and clean or discard if there is a significant risk of contaminating produce.

Product identification and traceability

To ensure fresh produce that is contaminated or suspected of being contaminated can be rapidly identified, withdrawn or recalled and appropriately disposed, the following records and practices are needed:

- ✓ Clearly mark each fresh produce package or container with identification, including the packer's name or brand, address and packing date or batch identification code. If fresh produce from more than one grower is packed under the same name or brand, identify each package with a name or grower code to enable traceability to each farm.
- ✓ Keep records of the growing location, harvest date, packing date/batch identification code, quantity supplied and destination for each consignment.
- ✓ Keep records of the production and postharvest practices related to food safety. This includes records of all fertilisers and soil additives, crop sprays, sanitisers, postharvest treatments and test results.

Testing produce

Preventative measures are clearly superior to microbial testing in assuring the safety of fresh produce. Microbial testing of produce can verify the effectiveness of management practices used to prevent, reduce or eliminate contamination. The *Guidelines for On-Farm Food Safety for Fresh Produce* provides information on microbial testing of produce.

Reviewing practices

The keys to marketing safe fresh produce are good agricultural practices during growing and harvesting and good hygiene and sanitation practices in the packing shed. To ensure practices remain effective it is essential to review all practices on a seasonal basis or when changes occur. Re-assess the risks whenever there are any changes to growing practices such as changes to the water source, irrigation system, fertilisers and soil additives or activities nearby to the crop, and changes in the packing shed such as changes to the water source, washing steps or postharvest treatments, new equipment or new workers.

Reference: *Guidelines for On-Farm Food Safety for Fresh Produce*, 2nd Edition 2004 Department of Agriculture, Fisheries and Forestry
www.daff.gov.au/corporate_docs/publications/pdf/food/nfis/guidelines_onfarm_food_safety_fresh_produce_2004.pdf

Water sanitation options for fresh produce preparation

Product name	Sanitiser constituent	Advantages	Disadvantages	Monitoring	Compatibility*
Klorman® Activ 8®	Calcium hypochlorite	<ul style="list-style-type: none"> Relatively inexpensive and easy to use Effective against most organisms Disinfection capabilities well known Tolerant of water hardness 	<ul style="list-style-type: none"> Inactivated by organic matter Requires pH control (6.0-7.5) Corrosive to metal 	pH and chlorine Use test strips or meters	Tecto®500SC
Vibrex® Oxine®	Chlorine dioxide	<ul style="list-style-type: none"> Not affected by organic matter in water Effective at low concentrations Less dependent on pH than Calcium hypochlorite 	<ul style="list-style-type: none"> Must be generated on site Explosive at high concentrations Comparatively expensive Requires good ventilation to avoid irritation to workers 	Redox probe	Spin®Flo Panoctine® Tecto®500SC Zanoctine® Goldazim®500SC Imazagard®800EC Magnante®500EC Bavistan®FL 500SC Fungaflor®500EC
Nylate®	Chloro-bromine compounds	<ul style="list-style-type: none"> Not as affected by organic matter in water as Calcium hypochlorite Less dependent on pH than Calcium hypochlorite Low corrosion 	<ul style="list-style-type: none"> Must be generated on site 	Automated analyser	Spin®Flo Tecto®500SC Panoctine® Zanoctine® Goldazim®500SC Bavistan®FL 500SC
Iodoclean™	Iodine	<ul style="list-style-type: none"> Stable in high organic loads Effective at broad pH range Some fungicidal activity Automated control 	<ul style="list-style-type: none"> Corrosive to metal 	Automated analyser	Not known – iodine has a comparatively lower oxidising potential than most other sanitisers so may be compatible but not yet tested.
Tsunami® 100	Peracetic acid or peroxyacetic acid	<ul style="list-style-type: none"> Stable in high organic loads Biodegradable by-products Relatively stable in liquid form 	<ul style="list-style-type: none"> Hazardous at high concentrations Strong oxidant High temperature and high pH cause inactivation May require neutralisation of waste water 	PAA test strips Automated analyser	Tecto®500SC Panoctine® Zanoctine® Guazacure® Goldazim®500SC Imazagard®800EC Bavistan®FL 500SC Magnante®500EC / 800EC / 750WG Fungaflor®500EC

*Compatibility is defined as: greater than 50% of the sanitiser's active constituent persisted when mixed in solution with the fungicide formulation for 4 hours.

*Effects on fungicide efficacy not evaluated

*Compatibility data for Spin®Flo is only for sanitiser persistence at 1 hour.

Notes: Ozone is not included as a recommended treatment for recirculated washing systems or postharvest treatment (fungicide) tanks as concentrations may be highly variable and cannot be readily determined or monitored to ensure sanitation is effectively maintained during the wash or treatment operation.

Heat treatment may be an option for some types of produce. For example, water heated and maintained at 58-60°C will reduce levels of spoilage organisms and human pathogens on rockmelons. Caution – always test hot water treatments for a sample of produce to check that the heat treatment does not damage the produce.

References: 1. *Guidelines for the management of microbial food safety in fruit packing houses*: 2002 Department of Agriculture Western Australia. www.agpsrv38.agric.wa.gov.au/pls/portal30/docs/folder/ikmp/hort/fn/pw/bull4567.pdf.

2. *Compatibility Guide: Representative fungicides and sanitiser groups used in citrus packingsheds*. South Australian Research and Development Institute (SARDI)

3. *Packer Newsletter* Volumes 59, 76, 78 & 81 (SARDI) www.sardi.sa.gov.au/pages/supply/postharvest_hort/citruspacker_news/newsletter.htm.

CAUTION: Always read the label. Users of agricultural chemical products must always read the label and any Permit before using the product and strictly comply with the directions on the label and the conditions on the Permit. Users are not absolved from compliance with the directions on the label or the conditions of the Permit by reason of any statement made or not made in this publication.