



VEGE *notes*

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Cool Chain

What is the Cool Chain?

Every process in the journey of delivering vegetables, right from the field through to the consumer, can be thought of as a link in a chain. When the optimum temperature of the vegetables is maintained from start to finish it is a 'Cool Chain'.



The Cool Chain: vegetable temperature management from Grower through to Consumer.

The *aim* of the Cool Chain is to:

- Deliver vegetables in fresh-picked condition
- Guarantee customer satisfaction
- Ensure consumer confidence and repeat purchases

By meeting the *aims*, the following *benefits* can be delivered:

- Increased sales of vegetables
- Higher prices and better margins
- Better profits for everyone involved
- Reduced wastage

Consumers want vegetables that look, smell and taste fresh.

This is achieved by harvesting vegetables at their optimum in the field. However, as soon as they are harvested quality begins to deteriorate.

To deliver the fresh vegetables consumers are looking for, deterioration must be slowed. The best way to achieve this is to quickly cool vegetables and maintain the temperature throughout the marketing chain.

Managing the correct temperature of vegetables through the Cool Chain benefits vegetable quality by minimising:

- weight loss
- wilting
- softening
- limpness
- bruising
- texture degradation
- colour changes
- the growth of rots, moulds and other organisms

The Cool Chain in Action

The Cool Chain is working when the optimum temperature of the vegetables is maintained at every step, between the grower and the consumer. Vegetables change hands many times during the journey and each change is a potential break in the Cool Chain.

Everyone who handles fresh vegetables during

The bottom line

- Produce quality is directly related to Cool Chain management
- Produce must be handled correctly from the beginning of the chain
- Probe thermometers are a vital tool for temperature monitoring
- Temperature data loggers collect temperature details throughout the chain and allow timely improvements to be made when necessary

this process needs to be actively aware of the Cool Chain, including:

- growers and their workers
- packers and staff
- transport companies and truck drivers
- wholesalers and distribution centres and staff
- retailers and staff at retail shops
- consumers



The Produce Handling Guidelines poster shows the optimum storage and transport conditions for a wide range of vegetables.

Without cooperation from all of these groups, the vegetables would not reach the consumer in the best possible condition.

People often wonder how vegetables can look so good in the field yet so bad by the time they get to the shop. Each sector (grower/packer, transporter, wholesaler, retailer) often blames the other. A small break in the Cool Chain can create a big problem in product quality when it reaches the consumer.

Starting the Cool Chain

Quality vegetables for the consumer starts with good quality in the field. With all the time, effort and expense required to grow vegetables it is critical that the final steps of harvesting, packing, cooling and transporting do not cause damage or premature deterioration.

Growers need to follow best practice methods of harvesting to preserve the physical appearance and condition of the vegetables, these include:

- careful harvesting
- picker instruction & supervision
- using clean picking containers

- placing, rather than dropping vegetables
- gentle handling and transportation

The Cool Chain needs to start the moment vegetables are harvested. Harvesting vegetables when they are cool gives the Cool Chain a good start.

One technique is to harvest early morning or at night, with some vegetables benefiting from using sprinklers prior to harvest to keep them cooler.

Once harvested, it is sensible to avoid letting the vegetables heat up. They should be kept in the shade (or covered) to avoid an increase in temperature. Regularly transporting harvested vegetables back to the shed for cooling and/or packing will also help maintain temperature.

Research shows that vegetables not at the appropriate temperature before being transported to the market are rarely ever properly cooled.

Transport vehicles are not designed to cool but only to maintain the temperature of pre-cooled produce. It is the responsibility of the grower/packer to start the Cool Chain by properly cooling the vegetables at packing.

Growers may be tempted to send produce to market without proper cooling to save time but it should be a priority. Harvest, packing and cooling times need to be organised to allow sufficient cooling time prior to transportation.

Growers can gain even more flexibility by using rapid cooling techniques, which can drastically cut the cooling time compared with simply standing vegetables in a cool room. Rapid cooling also benefits product quality by quickly reducing the rate of deterioration.

Rapid Cooling

Forced-Air Cooling is a Breeze

Forced-air cooling is fast. It can easily cool most vegetables within 6 to 8 hours, and often considerably faster. Forced air cooling can be used on just about any container type, from the field or as a final packed product providing the container has suitable ventilation.

A forced-air cooling system can be set-up within many existing cool rooms.

Basically, a dedicated fan draws cold air through the containers and directly over the individual vegetables in each container. It is much more efficient than simply leaving the boxes of vegetables on pallets sitting in a draught of cold air.



Forced-Air cooling is a rapid cooling method that is simple to set-up and run. More information on cooling methods is available at the SARDI Cool Handling website.

Rack Cooling

Rack cooling is a variation of basic room cooling that increases the air flow over each container of vegetables. Each container is placed onto a racking system so air can flow around each container. There is a requirement of extra handling in the system to re-stack the produce in the cool room. For most situations forced-air cooling is a better option.

Hydro-cooling

Hydro-cooling is the process of cooling produce by immersion or exposure to cold water. There are two main types available, shower or immersion type coolers. Both systems can be performed in-line along a conveyor belt or loaded as a batch. Only vegetables tolerant to water contact are suitable. Cooling is very fast, although it is dependent on product size and type. Water must be free from decay organisms and pathogens. As most systems recirculate water, a sanitation system is usually required.

Vacuum Cooling

Vacuum cooling is another very rapid cooling technique. The mode of cooling is quite different from the other systems listed.

It works by placing produce in an airtight chamber, reducing atmospheric pressure inside the chamber, which consequently reduces produce temperature by evaporating water from within the produce itself. It is typically used on leafy vegetables where there is a high surface to volume ratio.

Specially designed vacuum coolers can also shower water through the vegetables. The introduction of water into the system enables other vegetable types (such as carrots) to be successfully vacuum cooled.

One of the key advantages of the vacuum cooling is that vegetables can be rapidly cooled, even when they are packed (provided the packaging is not airtight).

Package icing and Liquid icing

Placing a layer of ice on top of warm produce will not adequately or evenly cool vegetables. This process should only be used to assist in maintaining vegetable temperature. To properly cool produce, the ice needs to come in contact with all the vegetables in the container. This can be achieved by liquid icing, where a water/ice slurry is injected into containers of vegetable to cool them.

Measuring Temperatures

Instinctively, when we want to check the temperature of something, we feel it. But touching vegetables isn't a very good way to establish temperature.

That will only give a rough indication of its surface temperature. Furthermore, simply looking at the temperature read-out on the outside of the cool room doesn't give the product temperature either. To properly understand what is happening in the Cool Chain we need to measure vegetable temperatures.



Probe to the middle

The only way to be really sure of pulp temperature is to measure it with a probe thermometer that pierces to the middle of the vegetable. This is particularly important with larger vegetables. Digital probe thermometers are cheap and every packing operation should have at least one. Only by probing produce can you really understand what the temperature of your produce is in the field, during packing and in the cool room.



Probe thermometers are the only way to properly measure vegetable core temperature.

Data Loggers

There are also continuous temperature monitors, known as temperature data loggers. There is a large range available; loggers with probes are particularly useful.

Temperature loggers are very compact and can easily fit in a box along with the produce. To retrieve the results the logger is attached and downloaded to a computer.

Loggers can be placed with produce in the field and temperatures tracked right through to the destination market.

The information collected can then be used to identify if and where any breaks in the Cool Chain are occurring. The results collected are often quite surprising, and with the decreasing cost of loggers, it is something all vegetable producers should be involved with.

Summary

The Cool Chain is important for delivering high quality vegetables to the consumer. Consistent high quality will help to drive sales and encourage repeat purchases. To achieve this, everyone involved with handling vegetables must ensure that the temperature is maintained through good postharvest practices.

The chain will only ever be successful if the product is handled correctly from the start. Vegetables should be handled carefully and cooled quickly and thoroughly prior to shipment.

To ensure good temperature management is in place, vegetable temperature should be measured with a probe thermometer.

Temperature data loggers can measure temperatures right through the chain, and the information gathered used to implement improved Cool Chain procedures.

Further Reading

SARDI Cool Handling website:
<http://www.sardi.sa.gov.au/coolchai>

Available from the PIRSA Resource Centre,
 1800 356 446:

- Produce Handling Guidelines poster, SARDI
- *Vegetables: Quality is Cool* (1999) by M. Palmer and A. Dahlenburg, SARDI



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