iFoodDS®

Hidden Causes of Shrink: A Look at Shelf Life Variability for Fresh Produce

Corinne McCarthy
Content Marketing Manager

When fruits and vegetables spoil prematurely, it hurts your customers and your bottom line. Increased food waste, lost profits and sales, and dissatisfied shoppers are all consequences of produce that doesn't live up to its promised shelf life. Consumers usually blame retailers when produce spoils, but shelf life issues are complex and often start at various stages of the supply chain.

Here is a look at factors that affect shelf life across the supply chain. Retailers need to work with their employees and business partners to identify which of these factors are affecting their own commodities. Only then can the root causes of shrink be addressed.

In this white paper you will learn about:

- Growing Conditions
- Harvest and Post-Harvest Conditions
- Transportation and Storage Conditions
- Storage and Display at the Grocery Store

Growing Conditions

Growing conditions determine the baseline quality that packer-shippers start with at harvest time. Different climates may affect sizing, taste, appearance, and overall quality. Growing season, on the other hand, is a more volatile factor that often causes quality to fluctuate at different points in the season.

When retailers are working with multiple suppliers and sourcing product from multiple growing regions, it's important to be cognizant of seasonal trends so quality issues can be anticipated. Awareness of seasonal fluctuations in quality can be achieved from collecting and analyzing years' worth of data on each commodity. This kind of data capture is a major undertaking, but the insights are invaluable. Having an idea of what kind of quality to expect from different regions during different times of the year will guide your sourcing decisions, inform your quality specs, and help you better allocate inspector resources to catch potential issues.

Adverse weather events and unseasonable weather patterns can also cause fluctuations in produce quality that ultimately influence shelf life. To illustrate this, here are some recent examples of real-life weather events and how they impacted the quality and shelf life of produce.

Cold Desert Temperatures Cause Lettuce Ice

In December 2021, low temperatures in the California and Arizona desert growing regions caused lettuce ice, a defect that leads to epidermal blistering and epidermal peeling (skin breaks down and turns brown). Lettuce ice also leads to faster decay when lettuce heads are exposed to the rain.[1]

Rain Decreases Strawberry Supplies in California

Persistent rain in California in December 2021 led to reduced strawberry supplies. The inclement weather limited harvesting and in some cases, prevented it altogether.[2]

Heat in Washington Lowers Volume and Shelf Life for Organic Apples

Organic apples harvested in the summer of 2021 in Washington state did not hold up as long as expected in storage due to high heat over the summer. Notably, organic apples suffered more than conventional apples because growers were unable to apply a heat protection product due to organic certification requirements.[3]

Harvest and Post-Harvest Conditions

As produce is harvested, the ambient temperature and humidity directly impact shelf life. The longer fruits and vegetables sit out in the field, the greater potential for lost shelf life – especially if the conditions are less than ideal (high temperatures and low relative humidity).

After harvest, most produce is precooled and then it is stored in a controlled temperature room until ready to ship. Although these conditions are usually more predictable, there can be variations that affect shelf life.

We'll look at two studies to illustrate how some of these harvest and post-harvest conditions can affect shelf life.

Study 1: Variability in the shelf life of table grapes from same batch when exposed under different ambient air conditions

In a study from Brazil, researchers studied the harvest and post-harvest conditions of table grapes that were all harvested from the same field.[4] The study was trying to dynamically predict shelf life based on the conditions the grapes were exposed to. There were several interesting takeaways that grocery retailers should note.

1. Harvest conditions were worst after late mornings when temperatures rose and humidity dipped. These conditions led to higher water loss rates, which typically translates to defects that may cause rejections and increase food waste.

2. Researchers found that variances in precooling tunnel conditions and time spent in cold storage led to temperature fluctuations and fruit weight loss in different places within a pallet. These factors often contribute to inconsistent quality and increased rejections.

3. Shelf life varied for grapes placed on different pallets, as well as grapes on the same pallet. Grapes positioned within the interior of pallets experienced more water loss due to temperature and humidity conditions. This decreased their shelf life.

Study 2: Time–Temperature Management Along the Food Cold Chain: A Review of Recent Developments

This comprehensive study was a peer review of other studies on cold chain temperature management.[5] In the section of the study devoted to the precooling stage, the authors showed how this step can vary based on multiple factors. Here are the key takeaways.

1. Many factors can influence the precooling process, including the harvest conditions, number of pallets, and produce packaging (overall design and material).

2. Additionally, mixing different commodities in the precooling process can lead to certain commodities being insufficiently cooled and others being cooled excessively.

3. Insufficient precooling can have long-term effects on food temperature throughout the cold chain, even if subsequent stages maintain the proper temperature. Therefore, it's critical to ensure this step is being performed properly.

Key Takeaways for Harvest and Post-Harvest Conditions

- Produce should be harvested at the best possible temperature and humidity and should be precooled quickly after harvest. Minimizing the time produce is left sitting in fields is essential.
- Precooling time and/or methods should be chosen carefully, taking into account the produce packaging, harvest conditions (warm or cool), number of pallets and bins per pallet, and whether there are multiple commodities being cooled at the same time.
- Packer-shippers should validate their precooling processes with temperature sensors and ensure that all of the commodities on each pallet are cooled to the appropriate temperature.

Transportation and Storage Conditions

Transportation is one of the most challenging stages of the supply chain. Cold chain compliance is essential for preserving shelf life, yet cold chain abuse is common. Many factors contribute to this. Here's a look at what can go wrong with transportation and storage, from the supplier to the distributor.

Initial temperature of the pallets

The initial temperature of the pallets as they're loaded into the truck may contribute to uneven temperatures inside the truck throughout transportation.[5]

Frequently opening truck doors

Pallets close to the truck door will be subject to greater temperature fluctuations every time the doors are opened.

Uneven airflow within the truck and pallets

The type of air delivery system (top-air vs. bottom-air) and load patterns in the truck trailer affect airflow and thus impact the temperature of the produce in the shipment. It's important to place product on pallets or racks in top-air delivery trailers to make sure there is enough return air space under the loads. For bottom-air delivery trailers, be sure to cover vertical air channels in the load that may be left by the different package sizes, shapes, or numbers. This ensures the air circulates throughout the whole load.[5]

Mixed commodities in a single load

Differences in packaging (size, shape, design, required temperature, etc.) contribute to product temperature variations during the transportation stage. If it isn't possible to ship temperature-compatible commodities, then the truck's temperature should be adjusted based on the most valuable or perishable commodity.[5]

Driver noncompliance

Drivers sometimes turn off the refrigerator in the truck at different points in the journey to save fuel, or fail to set the refrigerator at the right temperature from the beginning.

Transportation and Storage Conditions

Delays at the distribution center

Shipments are frequently unloaded at a DC but not inspected in a timely manner due to a variety of factors: high volume of loads to inspect, inefficient processes, employee shortages, etc. During this time, the produce sits unrefrigerated and loses shelf life. Alternatively, produce may sit on the truck as it waits to be unloaded and the driver may turn off the refrigerator to save fuel.

Overall, the cold chain temperature management study found that distribution centers usually store produce at the correct temperature.[5]

Therefore, the greatest threat to shelf life at this point lies in the transportation stage and the inspection process. A seamless cold chain and efficient inspection procedures help preserve the shelf life of fresh produce, while abuses in the cold chain and cumbersome inspection processes can reduce shelf life.

Key Takeaways for Transportation and Storage

The main factors that contribute to temperature fluctuations and/or cold chain abuse are:

- The initial temperature of the pallets as they are loaded into the truck
- Delays in unloading and/or inspecting the produce at the distribution center
- Frequent door opening (affects pallets near the door)
- Drivers turning off the refrigeration to save fuel
- Uneven air flow within the truck due to mismatched air delivery system and load patterns
- Mixing incompatible commodities in the same load and failing to adjust the temperature appropriately

Storage and Display at the Grocery Store

Once produce reaches the grocery store, employees need to make sure they are properly handling, storing, and displaying it to maximize shelf life. Here's a look at where shelf life loss can occur in the retail store.

Shipment Unloading and Storage

When shipments arrive, do employees have enough room in the storage area to unload it promptly, or does insufficient space cause delays?

The general rule of thumb is that every hour at room temperature equates to a shelf life loss of one day. For some commodities, this decay happens more quickly. For example, berries are especially sensitive to high temperatures. One study found that at 10°C/50°F, shelf life is lost three times faster for berries, reducing shelf life to one-third of its potential. At 30°C/86°F, the berries will have less than 10% of their maximum shelf life.[6] This example shows how important it is for your employees to promptly unload fresh produce and store it in refrigerated cases to preserve its shelf life.

The study cited above also highlights the importance of storing commodities at the proper temperature to preserve maximum shelf life. It's crucial to train employees on the proper conditions for different commodities. A berry is much more sensitive to temperature fluctuations than an apple, for example. The temperature of your refrigerated storage must be closely monitored and adjusted based on commodity.

Storage and Display at the Grocery Store

Employees also need to know the effects of storing incompatible commodities together. Fruits and vegetables that produce a lot of ethylene, like apples and onions, should never be stored near commodities that are sensitive to ethylene, such as grapes and carrots, because this will speed up decay. Make sure your produce department employees are trained properly and aware of the optimal way to store each commodity.

As demonstrated by the studies cited above, your retail employees need an in-depth understanding of produce handling and storage to maximize shelf life. It can be difficult to maintain this degree of knowledge given the high turnover rate in many retail positions. Scalabilty is imperative when it comes to training employees and evaluating produce quality. Grocery retailers are increasingly employing digital tools to assist in these areas.

Display

Returning to the study on cold chain management, the authors found that “storage in display cabinets is generally not the most efficient step in the cold chain, as the temperature frequently rises above the desired limit.” Some potential factors that contribute to this include “overloading the front of display cabinets or placing the racks at the highest position.” However, the authors report that in recent years, refrigeration at retail has improved.[5] It’s important for grocery retailers to evaluate whether every store location has adequate refrigeration, especially if some stores have older equipment that may be less efficient.

It’s also worth noting that the authors found temperatures varied at different positions in a display cabinet. Temperature was typically warmer at the top of the display cabinets. Additionally, the placement of the fruits and vegetables was often inefficient given the recommended display temperature.[5]

Storage and Display at the Grocery Store

The authors also provided some potential explanations for these differences in temperature based on position within the display cabinet:

- Penetration of ambient air
- Proximity to the lighting system
- Defrost cycle
- Heterogeneity of the airflow
- Differences in individual display cabinets
    - Type
    - Function
    - Efficiency
    - Set point temperature
    - Turnover rate
    - Door opening rate

Even for commodities that don't require refrigeration, the position of the produce display within your store has an impact on shelf life. Produce is sometimes stored too close to the doors, which subjects it to the outdoor temperatures as shoppers enter or exit. The temperature fluctuations from summer heat or winter cold can contribute to shrink.

Key Takeaways for Storage and Display at the Grocery Store

1. Employees need to promptly unload and store incoming produce to avoid letting it sit out and lose shelf life.

2. Employees should be trained on the proper storage conditions and temperatures for different commodities, and they need to be aware of which commodities can and cannot be stored together.

3. Display cabinets often rise above the recommended temperature and experience uneven cooling due to a variety of factors, including proximity to the lighting system, the defrost cycle, penetration of ambient air, efficiency, set point temperature, and turnover rate.

4. Placement of fruits and vegetables in display cases is often inefficient given the recommended temperature.

Do You Know the Real Shelf Life of Your Produce?

Are you concerned about shrink? Maybe you've noticed that some of your produce isn't living up to its expected shelf life, but without the data to back this up, you can't address the problem. All retailers should have a system in place to measure key metrics like average shelf life for different commodities and the total amount of shrink in the produce department.

Shelf life testing or evaluation is a good place to start. Your suppliers promise a certain shelf life, but do they deliver on that? You need insight into your produce quality and shelf life issues so you can start to investigate the root cause. By collecting data and analyzing larger trends, you can get an idea of what is contributing to shrink at your grocery store. For example, consider these two scenarios.

Scenario 1: A regional grocer collects data on shrink and shelf life at each of their 20 locations. They analyze the data and see that three particular stores have high rates of shrink and the lowest average shelf life. They conduct an investigation into the stores' produce handling procedures and realize that employees are running out of storage room too quickly. As a result, produce sits out on the floor for too long instead of going straight to refrigerated storage. The retailer modifies its order schedule so that they use up more produce before bringing in another shipment. Now the employees have ample room for storing incoming produce, and shrink is reduced.

Do You Know the Real Shelf Life of Your Produce?

Scenario 2:

A national grocer analyzes shrink and shelf life across all of its locations. It notices many stores throughout the United States are experiencing spikes in shrink. After digging into the data, the retailer finds that the high shrink is mostly coming from two suppliers. They reach out to these suppliers and share the data. The retailer and suppliers work together to identify the factors contributing to shrink. They realize that the packer-shippers are shipping mixed loads of commodities that require different storage temperatures. The packer-shippers adjust the temperature of their trucks to better preserve the most perishable items.

As these scenarios illustrate, the right data helps you identify shelf life issues so you can dig into the factors contributing to shrink.

Shelf Life Monitoring from iFoodDS

iFoodDS has developed a Shelf Life Monitoring Solution that provides a way for retailers to track vital shelf life data. Our digital solution lets you easily record the progression of deterioration and the total shelf life for different commodities. Map out suppliers, store locations, and other factors that can help you identify where the issue is originating. From there, you can present your retail team or supplier partners with the data and work collaboratively to identify the root cause.

Get more information about our Shelf Life Monitoring Solution or request a free demo.

Call: 206-219-3703 | **Email:** sales@ifoodds.com | **Visit our website:** www.iFoodDS.com

Get a Demo

References

1 The Produce Reporter, “Desert weather problems should push up prices,” December 23, 2021, https://www.producebluebook.com/2021/12/23/desert-weather-problems-should-push-up-prices/

2 The Produce Reporter, “California may miss out on rising strawberry demand,” December 30, 2021, https://www.producebluebook.com/2021/12/30/california-may-miss-out-on-rising-strawberry-demand/

3 Organic Produce Reporter, “Organic Apple Crop Feeling the Heat,” January 20, 2022, https://www.organicproducenetwork.com/article/1563/organic-apple-crop-feeling-the-heat

4 Cíntia Carla Melgaço de Oliveira, Davi Rocha Bernardes de Oliveira, and Vivaldo Silveira Junior, “Variability in the shelf life of table grapes from same batch when exposed under different ambient air conditions,” June 2021, https://www.scielo.br/j/cta/a/sJDHbM9QFfk4zRsC9pw9xxr/?lang=en

5 Samuel Mercier, Sebastien Villeneuve, Martin Mondor, and Ismail Uysal, “Time–Temperature Management Along the Food Cold Chain: A Review of Recent Developments,” May 29, 2017, https://ift.onlinelibrary.wiley.com/doi/10.1111/1541-4337.12269

6 M. Cecilia do Nascimento Nunes, Mike Nicometo, Jean Pierre Emond, Ricardo Badia Melis, and Ismail Uysal, “Improvement in fresh fruit and vegetable logistics quality: berry logistics field studies,” June 13, 2014, https://royalsocietypublishing.org/doi/10.1098/rsta.2013.0307 3.0307