

STORAGE AND HARVESTING TECHNOLOGY OF CHERRIES

(SWEET AND SOUR
CHERRIES)

Author: Prof. Nenad Magazin



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Sweet cherries and sour cherries do not ripen after being harvested, so they need to be picked when fully ripe.

It's vital to rapidly cool sweet cherries and sour cherries after harvesting to a temperature below 5°C.

The most effective cooling method for sweet cherries is cooling with icy water in hydrocoolers, while for sour cherries, it's the "forced air" cooling system.

We harvest sweet cherries and sour cherries with their stems as they indicate the fruit's freshness. If the stem is yellow or shrivelled, the fruit is overripe or hasn't been adequately stored.

The freshness of cold-stored sweet cherries and sour cherries is best stored in a modified atmosphere containing around 15% CO₂ and 5% O₂.



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Sour cherry is generally smaller yet more consistently sized compared to sweet cherry. Sweet cherries come in various colors such as yellow, yellow-red, and light or dark red, whereas sour cherries always exhibit a red hue. Another difference lies in the stem. At the base of the stem in sour cherries, cherry stems have leaflets.

Sweet cherries and **sour cherries** are among fruit species whose fruits can't be stored for extended periods, so the techniques and technologies for storing these fruit species are primarily focused on maintaining quality in the fruit distribution chain from producers to consumers. Sweet cherry and sour cherry belong to non-climacteric fruit species, meaning their fruits don't ripen after harvest, so accurately timing the harvest is vital for meeting consumers' preferences for fruit quality. Sweet cherries are mainly aimed at the fresh fruit market, while a significant portion of sour cherries are designated for freezing and processing. Nonetheless, a considerable portion of larger-sized, table sour cherry cultivars are marketed as fresh fruits. This publication will provide guidance not only for sweet cherries but also for harvesting and preserving table sour cherries.

METHODS FOR DETERMINING THE HARVEST TIMING

Often, fruits from single-colored sweet cherry cultivars are picked as soon as they turn red, before reaching full ripeness. While these fruits might endure transportation better, their organoleptic quality is poor, with low sugar content and high acidity.

Determining the best harvest time is crucial for the quality of the fruit and its longevity during distribution. For cherries destined for storage or lengthy transportation to consumers, it's vital to harvest them at their optimal state of maturity. If these fruits aren't meant for storage or lengthy transport but will reach consumers shortly after harvesting, we opt to harvest them when fully ripe. At this stage, they're larger, possess superior taste and aroma, and have an optimal sugar-to-acid ratio. However, if the intention is to store them in cold storage, an uncommon scenario, or spend prolonged transit to customers, we harvest them slightly before complete ripeness. This phase ensures they've accumulated sufficient soluble solid content, exhibit the characteristic color of their cultivar, and retain entirely green



Figure 1. Color scheme for determining cherry-picking moment

An evident indicator of whether sweet cherry and sour cherry fruits are overripe lies in the color of the stem. When the stem starts to yellow, it signifies that the fruit has begun to overripen and cannot be stored for long. The stem will soon dry up and detach post-harvest.

stems. Unlike apples or peaches, where we employ multiple maturity indices for harvest timing, sweet cherries, and sour cherries predominantly rely on fruit color as the primary indicator of ripeness.

1. Change in the color of the fruit skin. This method stands as the primary method used for harvesting sweet cherries and sour cherries for table consumption. Except for bicolored cherry cultivars, in other types of sweet cherries and sour cherries, the fruit color at full ripeness ranges from light to dark red, sometimes almost black. To ensure a reasonable harvest time, basic printed color charts (**Figure 1**) are used, allowing the tracking of fruit color change until it matches the cultivar's typical hue. Mobile applications are now available to precisely determine the harvest time.

2. Soluble solid content (SSC). The minimum content of soluble solids in sweet cherry fruits depends on the cultivar. For early cultivars, this content is quite low, while in late cultivars, it can exceed 20% (Table 1).

The storage capability of fruits also depends on the content of soluble solids. Fruits with higher levels of solids can be stored at lower temperatures, consequently prolonging their shelf life!

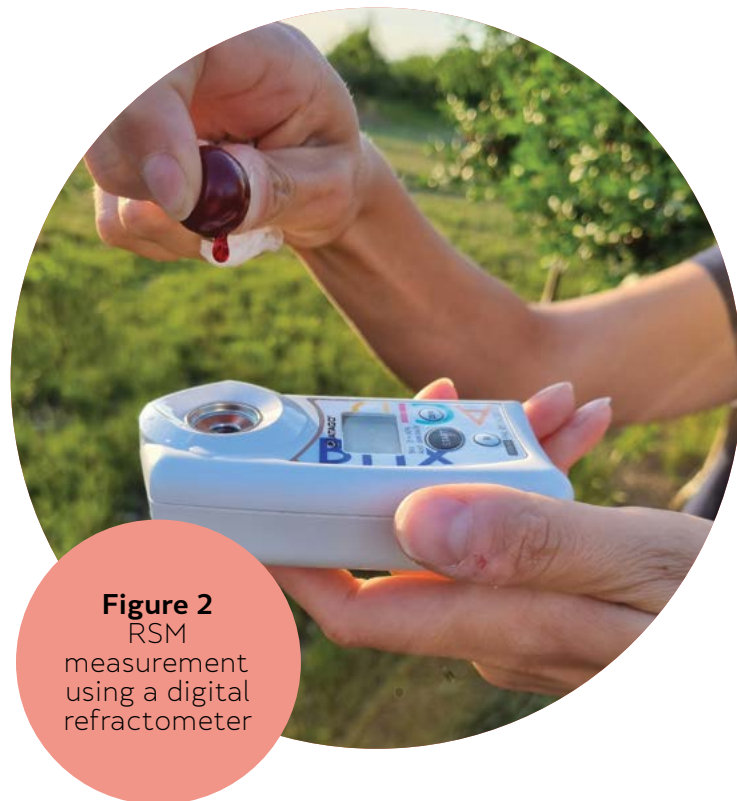


Figure 2
RSM
measurement
using a digital
refractometer

For most table sour cherry cultivars, the minimum SSC should be ≥ 14 . In the case of Oblačinska sour cherry cultivar earmarked for freezing and processing, the soluble solids content should be ≥ 16 at the time of harvest. Nowadays, producers have access to both analogue and digital refractometers (**Figure 2**) that allow for easy, rapid, and reliable measurement of the soluble solids content.

HARVESTING

Sweet cherry and sour cherry fruits meant for fresh consumption are solely handpicked. Harvesting is conducted either directly into packaging for sale (**Figure 3**) or into harvesting containers for later sorting and packaging. It is important to note that while sweet cherry fruits can be sorted afterward, sour cherry fruits cannot due to their softness. Even though harvesting in a single pass is ideal, these fruit species are often selectively picked in practice due to uneven ripening. Picking them all at once leads to a higher proportion of discarded fruits, as some are either too ripe or unripe. Fruits are picked with their stems as the stem is the best indicator of fruit freshness. Pickers should be trained accordingly, as any mechanical harm, such as bruising fruits with fingers or piercing them, creates conditions for decay and fruit spoilage. During harvesting, the picked fruits should be placed in a cool environment.



Figure 3
Harvested sour
cherry fruits in
packaging for
sale



TRANSPORT TO THE COLD STORAGE AND SORTING

The sweet cherries and sour cherries need to be moved from the orchard to the storage facility as quickly as possible and promptly cooled. Bear in mind that sweet cherry and sour cherry fruits are often harvested during periods of high temperatures and are warm themselves, making it crucial to cool them down promptly. The transportation time from the orchard to the storage or packing site shouldn't exceed 6-8 hours. During transportation, the fruits must be shielded from direct sunlight. When driving on uneven rural roads, the vehicle should avoid speeding to prevent any harm to the fruits. If the fruits are to be transported to the cold storage or distribution center for longer than 4-6 hours, they necessitate transportation in a vehicle equipped with a cooling system. Upon arrival at the cold storage (**Figure 4**), the fruits are immediately cooled (**Figure 5**) before being stored in the cold storage if they're already packaged for sale, or they are sent to the fruit sorting line (**Figures 6 and 7**), then packed (**Figures 8 and 9**), and placed in the cold storage before being dispatched to the market.

In the absence of a cold chain, meaning if sweet cherries and sour cherries are transported from the cold storage to the customer using vehicles without cooling systems, these fruits shouldn't undergo cooling before sale. This is because the presence of condensation on the fruit surface and a sudden surge in respiration would significantly elevate their deterioration rate!

Cherry sorting machines, or cherry calibrators, sort sweet cherry fruits by size while separating fruits that are connected at the base of their stems. These sorting machines are typically highly sophisticated, digitized, and made of materials that don't harm the fruits. Additionally, during sorting, the fruits are washed in cold water, maintaining a low temperature. It's advised to add chlorine to the water for disinfection to prevent disease development on the fruits.



Figure 4.
Reception of fruits in cooling chamber



Figure 5.
Passage of fruit crates through ice water



Figure 6.
A part of cherry calibrator

Figure 7.
Manual
control of
sorted fruits



**Figure
7 and 8.**
Cherry fruits
packed in two
different types
of retail
packaging



OPTIMAL STORAGE CONDITIONS

The fruits of sweet cherries and sour cherries exhibit a high respiration rate, leading to rapid decay, and ageing, and are prone to developing parasitic diseases, thus requiring immediate cooling upon arrival at the cold storage. Cooling sweet cherry and sour cherry fruits before storage can be achieved using either cold air or cold water in so-called hydrocoolers. Cooling with cold air, specifically with a “forced air” system, is more advisable if we intend to store the fruits for an extended period, as water cooling might lead to a higher incidence of fruit rot later in the distribution chain. Pre-cooling sour cherries with cold water is not recommended. The “forced air” cooling system (**figure 10**) allows for rapid temperature decrease of the goods that need cooling. This system is installed within a regular chamber with a cooling system and comprises powerful fans generating negative pressure in front of packed fruit pallets, directing cold air from the chamber to swiftly pass through the pallet, extracting heat from the fruits. Pre-cooling is conducted at a temperature of 4-5°C. If the fruits are meant for quick sale, they are temporarily stored at that temperature, sometimes even at temperatures up to 10°C. Subsequently, they are packed into



Figure 10.
“Forced air”
cooling
system

retail packaging, cooled again as they warm up during packaging, and then dispatched to the market in vehicles equipped with cooling systems. Should the fruits be reserved for storage, they are placed in chambers where the storage regimen outlined in **Table 1** is established.

Sweet cherries are successfully stored at temperatures between -1 to 0°C, with the recommendation that the interval from harvest to consumption should not exceed 7-10 days. If the fruits are stored in a standard cold storage with a regular

atmosphere, the storage duration should not exceed 15-18 days. Sour cherries are stored at a slightly higher temperature of 0°C and should not be stored for more than two weeks. In both fruit types, the stems age rapidly, turning yellow, then brown, and eventually drying and detaching from the fruit, significantly impacting their appearance. To prevent this, it's crucial to maintain high relative air humidity, around 95%. If extending the fruits' shelf life is desired, storage in modified atmosphere gas conditions can be considered.

Sweet cherries and sour cherries can be stored in controlled atmosphere (CA) cold storage, but this practice is rare as these fruit species are seldom stored.

Nevertheless, during transport, a modified atmosphere is employed for sweet cherries and sour cherries. Individual fruit packaging or entire pallets are wrapped in special films or bags that partially allow the passage of oxygen and carbon dioxide until the gas content specified in **Table 1** is achieved. Another method involves introducing the inert gas nitrogen into the packaging, displacing oxygen. With reduced oxygen content, the fruits respire at a significantly slower rate and deteriorate much slower. Another benefit of transporting or storing fruits in a modified atmosphere is the high relative air humidity, preventing the fruits, especially the stems, from losing moisture. It's been proven that the stems of fruits



Figure 11.
Cherry
fruits in
MAP bags

stored in MAP (Modified Atmosphere Packaging) (**figure 11**) maintain freshness and green color for a much longer time.

Figure 12 demonstrates that even after a month of storage, sweet cherries stored in MAP bags retain completely fresh and green stems. In contrast, those stored in a standard atmosphere, like in a standard cold storage, appear shrivelled, and lacking shine, and what is perceptible is they have yellow or brown, dried stems.

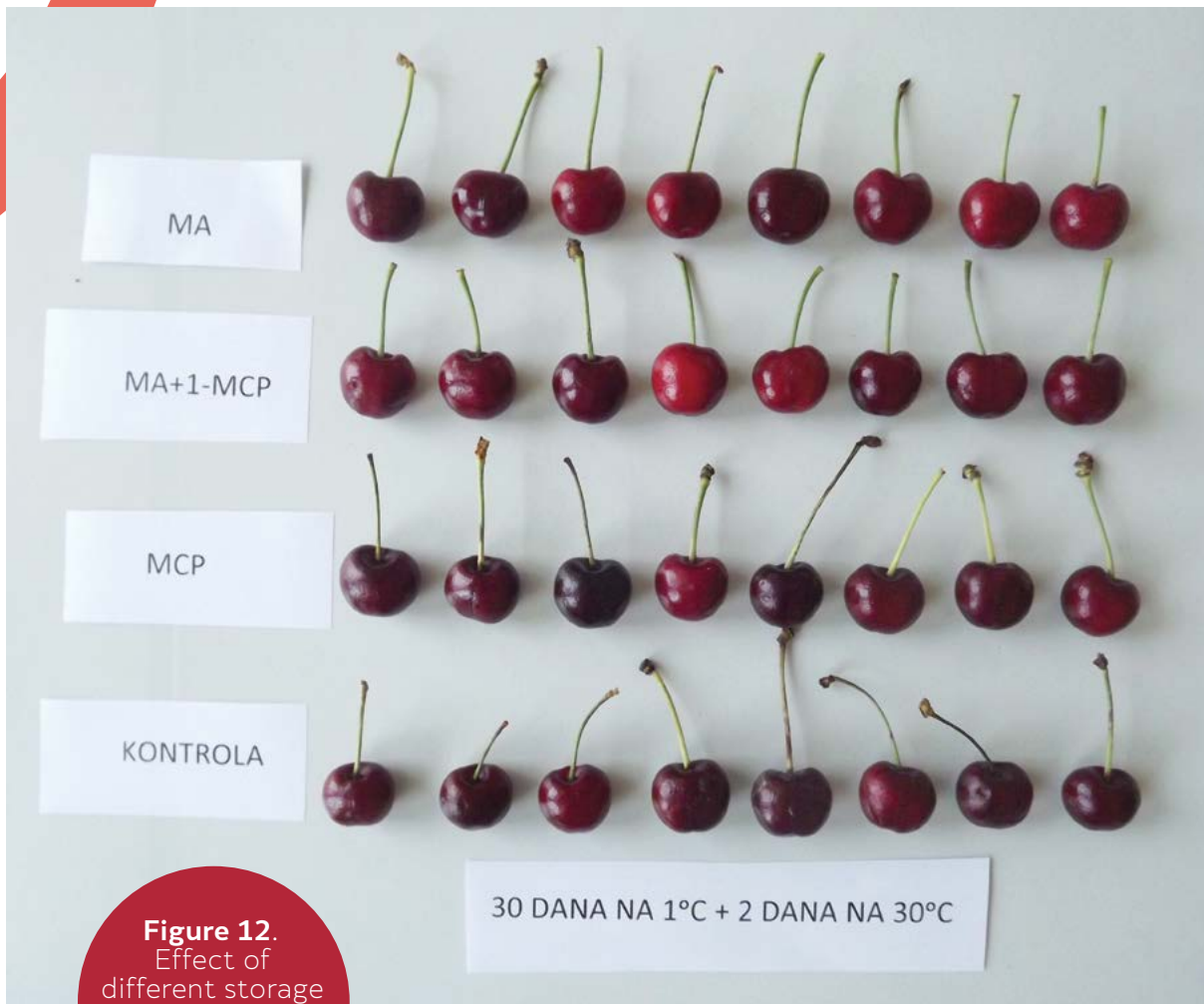


Figure 12.
Effect of
different storage
conditions on
cherry fruit
quality

30 DANA NA 1°C + 2 DANA NA 30°C

Table 1. Storage conditions for sweet cherries and sour cherries in normal (NA), controlled atmosphere (CA), and modified atmosphere (MAP).

	NA		CA		MAP	
	Temp (°C)	Rel. humid. (%)	O ₂ %	CO ₂ %	O ₂ %	CO ₂ %
Sweet cherry	-1,0 – 0,0	95	1,0 – 5,0	5,0-20,0	5,0-10,0	5,0-15,0
Sour cherry	0,0	95	1,5 – 2,0	5,0	5,0-10,0	5,0-15,0

Properly harvested and stored fruits, further in packaging and distribution on the international market, adhere to the international standards for fruits and vegetables of the Organisation for Economic Co-operation and Development (OECD). All details related to the standards concerning sweet cherries and sour cherries can be found in the brochure at following link: https://www.oecd-ilibrary.org/agriculture-and-food/cherries_9789264248625-en-fr

