



Economic Commission for Europe

Steering Committee on Trade Capacity and Standards

Working Party on Agricultural Quality Standards**Specialized Section on Standardization of Fresh Fruit and Vegetables****Seventieth session**

Geneva, 16-18 May 2022

Item 5 of the provisional agenda

**Sustainable Development Goal 12 and sustainable practices:
food loss and waste prevention related to standards****Good practices in harvest and post-harvest handling of leafy
vegetables****Submitted by the secretariat***Summary*

In 2021, a second edition of the *ECE Code of Good Practice – reducing food loss and ensuring optimum handling of fresh fruit and vegetables along the value chain* was developed by an ad-hoc drafting group under the Specialized Section for Standardization of Fresh Fruit and Vegetables and presented to the 76th session of the Working Party on Agricultural Quality Standards. The Code of Good Practice contains recommendations for optimal handling of fresh fruit and vegetables along the supply chain avoid food loss. For ease of use, it has separate chapters for different supply chain actors: primary producers, traders, transporters, and retailers.

In addition, to increase the uptake and use of the Code of Good Practice, it was proposed to develop hands-on guidance material with illustrative pictures for practical use (informal document ECE/CTCS/WP.7/2021/Inf.2). Thus, with funding from a United Nations Development Account (UNDA) project, such recommendations have been developed covering four groups of vegetables for which common guidelines and recommendations apply, namely: floral vegetables; immature fruit vegetables; leafy vegetables; and root vegetables.

The present document covers leafy vegetables.

The Specialized Section for Standardization of Fresh Fruit and Vegetables is invited to review the draft. It is also invited to consider the merits of covering a wider range of products by similar guidance material, and if so, if it should cover product groups or specific products in line with the trade standards.



Code of Good Practice: Good practices in harvest and post-harvest handling of leafy vegetables

I. Introduction

The use of good practices, when vegetables are harvested and subsequently handled, are central in reducing losses and waste. These recommendations, that cover leafy vegetables, aim to provide practical guidelines for handling this group of products and thereby to supplement the recommendations given in the Code of Good Practice.¹

Good practices during harvest and postharvest are important to assure food safety and keeping quality. In this document, emphasis is given to keeping quality, with practices that keep the produce sound, extends shelf life and reduce food loss and waste.

One must have in mind that keeping the produce sound is important to guarantee its safety, but it is not enough. A high-quality lettuce head can look good and yet be unsafe due to its contamination with food-borne pathogens or toxic chemicals. On the other hand, a wilt and yellow lettuce, although a low-quality produce in terms of flavour, can be safe.

The recommendations listed in this guidance do not guarantee food safety. More specific guidelines are available at Codex Alimentarius.²

II. Good practices for keeping quality

There is more than one way to implement good practices in the leafy vegetables supply chain, depending on the size of the business, the technological level and the market demand on quality and presentation of the produce.

In all cases, the following conditions should be met:

1. Handle the produce as little and as carefully as possible to avoid physical damage.
2. Protect the produce from damaging environmental conditions like direct exposure to sunlight, wind and dust, inappropriate temperature and air humidity and rain or hail, all the way from producer to point of sale.
3. Protect the produce from exposure to ethylene.
4. Keep hygiene in all steps of the supply chain to avoid contamination by plant and foodborne pathogens.
5. Coordinate operations to assure fresh product arrives in the market as soon as possible after harvest.

III. Primary Producers

Harvesting and postharvest operations should be fast enough to prevent warming and dehydration of the produce, but careful enough to prevent physical damage. For that, it is important to consider the following:

Before harvest:

¹ Code of Good Practice – reducing food loss and ensuring optimum handling of fresh fruit and vegetables along the value chain, available at: https://unece.org/sites/default/files/2021-11/WP7_2021_INF1_0.pdf

² Codex Alimentarius (2017). Code Of Hygienic Practice for Fresh Fruits and Vegetables: https://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FStandards%252FCXC%2B53-2003%252FCXC_053e.pdf

- Organize the orders at least one day in advance, so that the harvesters know, beforehand, the quantity to be harvested, and the quality standards and presentation demands by the client.
- Ensure that harvest equipment, containers and tools are clean and available to field workers before they start harvesting.

During harvest:

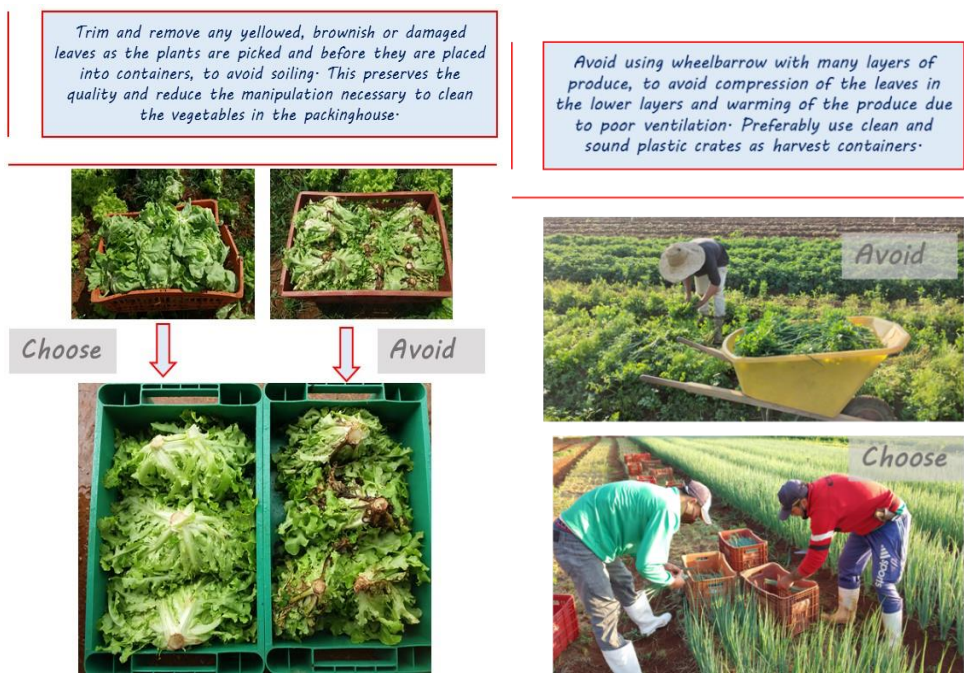
- Harvest at the right stage of maturity, in order to obtain the best keeping quality and sensorial quality. For leafy vegetables, maturity is defined by size and by the head being compact (head lettuces, Chinese cabbage, and cabbage). The importance of maturity for keeping quality is exemplified with head lettuce and cabbage: soft lettuce heads are easily damaged, while firm heads have maximal storage life; hard and extra-hard heads are more prone to develop russet spotting, pink rib, and other physiological disorders. Immature cabbage heads are softer and have an excessive tendency to wilt while overmature heads are more susceptible to splitting, pathogens, physiological disorders, and seed stalk formation.

A. Harvest methods and tools

Preferably, harvest, clean and pack in the field. When this is not feasible, reduce as far as possible the number of operations, to avoid physical damage. Remember that leaves and midribs are broken easily, with consequent darkening and decay.

<p>Harvest early in the morning or late in the afternoon. Clean crates should be available in the field before harvest begins.</p>			<p>Harvest early in the morning or late in the afternoon. Remove damaged leaves and bunch the products carefully, to avoid compressing and damaging the leaves and midribs.</p>
<p>Use clean and sharp tools to cut the plants, remove damaged leaves and pack the vegetables in plastic bags.</p>			<p>If transport is not readily available, protect the plants from direct sun light and wind and, under dry weather, sprinkle the plants with clean water.</p>
<p>Place the plastic bags carefully in clean crates that will go directly to the market or distribution chain.</p>			<p>Wash with clean water, remove damaged leaves and pack in plastic bags. Label or colour code crates for harvesting (red in the photo) and marketing (grey in the photo).</p>
<p>Protect vegetables from direct sun light and winds during transport. Covered canopies also protect the product from birds dropping.</p>			<p>Place the plastic bags in the container, avoiding overfilling.</p>
	<p>Field packaging</p>	<p>Packaging in a packinhouse</p>	

Photos: Milza Moreira Lana, EMBRAPA



Photos: Milza Moreira Lana, EMBRAPA

B. Cleaning of containers, tools and equipment

Cleaning the containers and tools is important not only to avoid produce contamination but also to prevent physical damage. The presence of soil and other debris can cause micro wounds that reduce the shelf-life of the produce.

Cleaning with water and soap is enough to get rid of debris and most plant pathogens. In infected fields, cutting tools are a primary source of disease carryover. In this case, tools and containers should be cleaned and sanitized at the end of the day. Plastic crates can be cleaned with a pressure washer or a crate machine washer, depending on the volume of crates to clean.

Cutting tools should be sharp.

C. Postharvest operations

Depending on the size of the business and on the complexity of postharvest operations, the postharvest facilities can be as simple as a packaging shed, as complex as an automated facility and everything in between.³

For both field packed or packing-house packed produce, removal of field heat can be performed by hydrocooling, forced-air cooling and top-ice cooling.⁴

³ For more information on how to build a packing facility, see: FAO (2012). Good practice in the design, management and operation of a fresh produce packinghouse, Food and Agriculture Organization of the United Nations Regional Office for Asia and the Pacific Bangkok, 2012, available at: <https://www.fao.org/3/i2678e/i2678e00.pdf>

⁴ For more information on each of these methods, consult NC State Extension, Proper Postharvest Cooling and Handling Methods: <https://content.ces.ncsu.edu/proper-postharvest-cooling-and-handling-methods>

Be consistent with bunch or bag sizes in the same batch, to avoid rummaging from customers looking for the bigger one. Tie bunchs carefully to avoid physical damage or pack them loose in a plastic bag.



Be careful when choosing the kind of film to use for wrapping the vegetables. More permeable films and open plastic bags are recommended when the product is not refrigerated.

Photos: Milza Moreira Lana, EMBRAPA

IV. Traders and Transporters

Leafy vegetables must be kept in high humidity to inhibit water loss. However, the presence of free water in the leaves, when associated with physical damage, favours microbial decay. It is important to provide adequate ventilation in the cargo, to remove the heat produced by respiration. However, too much ventilation accelerates water loss. Leafy vegetables should not be transported or stored for long together with ethylene producing ripening fruits.⁵

Record parameters affecting quality. This can be done using telematics (remote temperature monitoring) or temperature recorders. Based on deviations from optimal temperature and humidity one can manage how fast the produce should be marketed and how long it can be stored (potential shelf-life).

The use of proper and correctly stacked packaging is essential to avoid damage due to compression and vibration of the load. Correct load distribution is also important to ensure adequate ventilation and to remove the heat produced by respiration without promoting dehydration. Insufficient ventilation is a major cause of losses during transport, even under optimal temperature conditions.⁶

⁵ Check the compatibility of leafy vegetables and other fruits and vegetables at Code of Good Practice – reducing food loss and ensuring optimum handling of fresh fruit and vegetables along the value chain, available at: https://unece.org/sites/default/files/2021-11/WP7_2021_INF1_0.pdf

⁶ For more detailed information on transport of leafy vegetables, including guidelines for specific produce and produce compatibility, see: University of Florida (2019), Protecting Perishable Foods During Transport by Truck and Rail, available at: <https://edis.ifas.ufl.edu/pdf%5CHS%5CHS132800.pdf>

Avoid physical damage at all stages of the supply chain. Small wounds rapidly evolve to darkening and rotting.

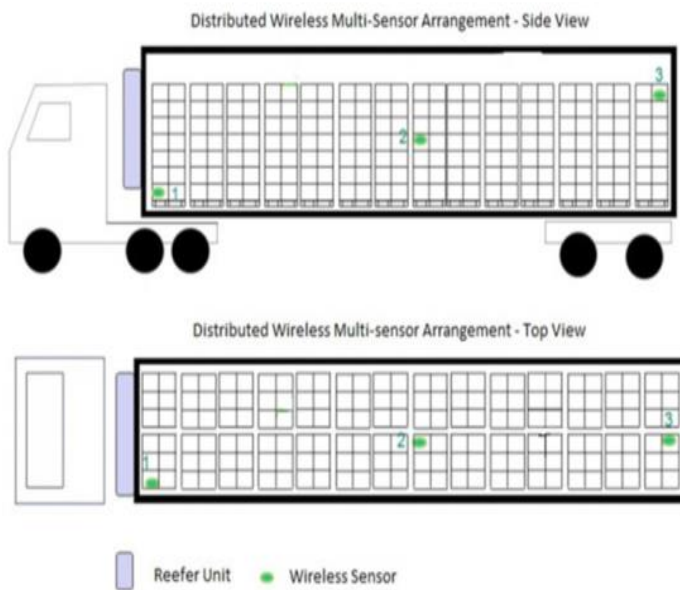
At the farm and during transport



At the market



Temperature recorders must be installed inside the pallet in three locations: the first pallet near the front bulkhead of the reefer unit; near the center of the load; last pallet at eye level.



From: Brecht et al. 2019. Protecting Perishable Foods During Transport by Truck and Rail

Photos: Milza Moreira Lana, EMBRAPA

V. Retail

A. Display products appropriately

Leafy vegetables lose water rapidly. Whenever possible they should be displayed under high relative humidity and refrigerated.⁷



Photos: Milza Moreira Lana, EMBRAPA

B. Choose responsible promotional campaigns

- Inform the consumer about changes in size, colour and shape due to weather conditions that, despite their deleterious effects on appearance, do not compromise safety, flavour or nutritional value.
- Instead of promotions such as “buy 2, pay 1”, go for campaigns about health eating (eat vegetables for health), cross merchandizing (escarole and pizza dough), variations in well-known dishes (add rocket to pasta for freshness), add extra flavour (leek and celery in meat dishes).
- Provide recipes and recommendations on how to store the produce at home, for keeping quality, in promotional leaflets and the company website.

⁷ Retail outlet display considerations for individual produce are available at USDA (2016), The Commercial Storage of Fruits, Vegetables and Florist and Nursery stocks, Agriculture Handbook Number 66, United States Department of Agriculture, February 2016, available at: www.ars.usda.gov/is/np/CommercialStorage/CommercialStorage.pdf

VI. All stages of the supply chain

A. Measure the losses and waste

Use the simple UNECE methodology to record losses and waste from production to wholesale levels.⁸ Then integrate these data into an IT-based smart food loss management system to help trace and make food visible which would otherwise be lost or wasted and create opportunities to re-distribute food through or to alternative food chains.

⁸ ECE (2020), Simply Measuring - Quantifying Food Loss & Waste: UNECE food loss and waste measuring methodology for fresh produce supply chains, ECE/TRADE/453, Geneva 2020. Available at: <https://unece.org/sites/default/files/2021-04/FoodLossMeasuringMethodology.pdf>

Annex

Additional information and links

General

Asian leafy vegetables postharvest handling:

<https://www.postharvest.net.au/imagesDB/wysiwyg/1-Asianleafyvegetables42.pdf>

Harvesting and handling of traditional African vegetables:

<https://www.nap.edu/read/11763/chapter/18#288>

Chlorination: <https://content.ces.ncsu.edu/chlorination-and-postharvest-disease-control>

Postharvest handling of leafy vegetables: <https://worldveg.tind.io/record/37859/files/?ln=en>

Postharvest handling of lettuce:

https://postharvest.ucdavis.edu/Online_Extension_to_Educate_Small_Farms/Handling_Lettuce/

Postharvest handling of fresh herbs:

https://postharvest.ucdavis.edu/Online_Extension_to_Educate_Small_Farms/Handling_Herbs/

Maturity at harvest

Recommendations on horticultural maturity indices for individual produce are available at the website of University of California, Division of Agriculture and Natural Resources (UCDAVIS). Produce fact sheets:

https://postharvest.ucdavis.edu/Commodity_Resources/Fact_Sheets/

USDA (2016), The Commercial Storage of Fruits, Vegetables and Florist and Nursery stocks, Agriculture Handbook Number 66, United States Department of Agriculture, February 2016, available at: www.ars.usda.gov/is/np/CommercialStorage/CommercialStorage.pdf

Post-harvest operations

For more information on how to build a packing facility, see: FAO (2012). Good practice in the design, management and operation of a fresh produce packing-house, Food and Agriculture Organization of the United Nations Regional Office for Asia and the Pacific Bangkok, 2012, available at: <https://www.fao.org/3/i2678e/i2678e00.pdf>

NC State Extension, Proper Postharvest Cooling and Handling Methods: <https://content.ces.ncsu.edu/proper-postharvest-cooling-and-handling-methods>

Refrigeration and transport

For more detailed information on transport of leafy vegetables, including guidelines for specific produce and produce compatibility, see: University of Florida (2019), Protecting Perishable Foods During Transport by Truck and Rail, available at:

<https://edis.ifas.ufl.edu/pdf%5CHS%5CHS132800.pdf>

Know more about the basics of cooling vegetables in: Managing cooling of vegetables:

<https://youtu.be/VVDvVHa7xVA>

Retail

Retail outlet display considerations for individual produce are available at USDA (2016), The Commercial Storage of Fruits, Vegetables and Florist and Nursery stocks, Agriculture Handbook Number 66, United States Department of Agriculture, February 2016, available at: www.ars.usda.gov/is/np/CommercialStorage/CommercialStorage.pdf

Food loss and waste measurement

ECE (2020), Simply Measuring - Quantifying Food Loss & Waste: UNECE food loss and waste measuring methodology for fresh produce supply chains, ECE/TRADE/453, Geneva 2020. Available at: <https://unece.org/sites/default/files/2021-04/FoodLossMeasuringMethodology.pdf>

For more detail studies at retail level, see: Quantification of vegetable loss at retail market - methodology proposed for leafy vegetables: <https://ainfo.cnpia.EMBRAPA.br/digital/bitstream/item/219046/1/Lana-2020-Vegetable-Loss-Methodology.pdf>
