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**Economic Commission for Europe**

Steering Committee on Trade Capacity and Standards

**Working Party on Agricultural Quality Standards****Specialized Section on Standardization  
of Dry and Dried Produce****Seventy-first session**

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Item 5 of the provisional agenda

**Sustainable Development Goal 12 and sustainable food systems: food loss and waste prevention****Code of good practice for DDP – first draft****Submitted by the secretariat***Summary*

At its 2022 session, the Specialized Section decided to establish an ad-hoc drafting group consisting of the United States of America, Central Asian Working Group to Promote Exports of Agricultural Produce (CAWG), the International Nuts and Dried Fruit Council (INC), and Perlum Noix to work on developing a code of good practice for reducing food loss in nuts and dried fruit value chains. At its 2023 meeting, the Specialized Section reconfirmed its intention to develop such guidelines and decided that the drafting group would be led by the INC.

In early 2024, INC developed a draft text of the first chapter for primary producers which was further refined in three meetings of the ad-hoc drafting group during February-April 2024.

The Specialized Section is invited to review the draft text and provide comments and suggestions.



**UNECE Code of Good Practice:  
Reducing food loss and ensuring optimum handling of nuts and dried fruits along the value chain (first draft)**

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ANNEX I

Note 1:

The UNECE Code of Good Practice: Reducing food loss and ensuring optimum handling of fresh fruit and vegetables along the value chain (ECE/TRADE/470)<sup>1</sup> includes four chapters, on (1) Primary Producers; (2) Traders; (3) Transporters and (4) Retailers.

For this publication, INC suggests adding chapters on Processors (e.g., shelling, frying and dry roasting, contaminant detection, sorting) and Packers (e.g., retail packing, Modified Atmosphere Packaging, packaging materials) before the chapter on Traders.

Note 2:

The document has not been formally edited by UNECE.

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<sup>1</sup> Available at: <https://unece.org/trade/publications/code-good-practice-food-loss>

## INTRODUCTION

According to UN estimates, the world's population is predicted to reach over 9 billion by 2050, which will require a 60% increase in food availability.<sup>2,3</sup> However, if current levels of food loss and waste are reduced by half, only a 28% increase in production will be required to meet this goal.<sup>4</sup> Therefore, reducing food loss and waste is a far more efficient way to increase food availability than increasing food production.<sup>5</sup>

The food industry has historically relied on technological advances to reduce losses and increase efficiency; the nut and dried fruit sector is no exception. Investing in efficient, affordable and sustainable processing technologies and adequate storage and packaging solutions, means of transport and market links, as well as providing training and education to chain actors and consumers, are some of the tried-and-tested interventions that help increase the efficiency of the value chain and lead to a reduction in food loss and waste.

Compared to fresh fruits, nuts and dried/dehydrated fruits have low loss and waste levels. Drying/dehydrating as a method of preservation removes moisture from the fruits, which prevents the growth of bacteria and moulds. Like nuts, dried fruits also contain antioxidants.

Nuts and dried fruits are grown/produced both in orchard production systems (farming) and via agro-forestry conditions, as in the case of Amazonia (Brazil) nuts and pine nuts. They are produced in both multiple cropping systems (as a secondary crop or crop mix by small farmers) and monocropping systems (standalone orchards). The latter form dominates international production and trade volumes.

The production and trade of dried nuts and fruits are well documented in human history. Drying and/or dehydrating are the most ancient methods of food preservation. These dried products facilitate long, simple storage, ease of transportation and low transportation cost. As in ancient times, dried fruits and nuts are traded over large distances and involve several actors. However, the current focus is reducing losses and waste along the entire value chain, an effort that requires a practical integrated approach by all stakeholders throughout the entire production and trade system.

The level of loss and waste associated with nuts is lower than that of dried fruit. In-shell nuts are protected by shells, making them less susceptible to mould, insect damage, etc. Additionally, both in-shell nuts and nut kernels are also protected by their antioxidant content, which also provide them with a longer shelf life. Additionally, nuts that do not meet requirements for direct human consumption are assigned to other commercial purposes, including oil, skincare products and animal feed.

When nuts and dried fruits are handled and stored correctly, their shelf life is significantly extended, they can be transported easily across long distances, and their nutritional density and quality are maintained. However, as natural ingredients, they do not last forever. Because of its environmental and sustainability impact, food loss and waste within the food industry have received much attention in recent years. In the case of nuts and dried fruits, this topic is of significant importance given these products' high nutritional value, global utility and investments in their production, distribution and consumer safety.

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<sup>2</sup> Graziano da Silva, J. (2012). *Feeding the World Sustainably*.

<https://www.un.org/en/chronicle/article/feeding-world-sustainably>

<sup>3</sup> FAO (2016). *Climate change and food security: risks and responses*. <http://www.fao.org/3/a-i5188e.pdf>

<sup>4</sup> Van Otterdijk, R. (2023). *Food Loss and Waste Reduction in Europe and Central Asia*. Roundtable on sustainable food systems - digitalization and food loss and waste reduction, Geneva, Switzerland. <https://unece.org/trade/documents/2023/11/presentations/food-loss-and-waste-reduction-europe-and-central-asia-robert>

<sup>5</sup> Graziano da Silva, J. (2016, August 10). *Food losses and waste: a challenge to sustainable development*. FAO. <https://www.fao.org/save-food/news-and-multimedia/news/news-details/en/c/429182/>

Much can be gained, economically and in combating hunger and malnutrition, from taking measures to reduce losses and waste. According to estimates, investments in food loss and waste measures can yield a 14-fold return.<sup>6</sup> For further details, see the UNECE food loss and waste measuring methodology for fresh produce supply chains.<sup>7</sup>

This Code of Good Practice supports Sustainable Development Goal (SDG) 12 “Ensure Sustainable Consumption and Production Patterns”, specifically target 12.3 on reducing food loss and waste: “By 2030, halve per capita global food waste at the retail and consumer level and reduce food losses along production and supply chains, including post-harvest losses.”<sup>8</sup>

This Code has been drawn up by the United Nations Economic Commission for Europe (UNECE) to provide guidance to the nut and dried produce (fruit) sector on how to reduce losses and waste. Whereas the *Voluntary Code of Conduct for Food Loss and Waste Reduction* prepared by the Food and Agriculture Organization of the United Nations (FAO)<sup>9</sup> provides a generic framework, and the UNECE *Code of Good Practice: Reducing food loss and ensuring optimum handling of fresh fruit and vegetables along the value chain*<sup>10</sup> provides guidance to the sector on how to reduce losses and waste of fresh fruits —e.g., apricots, cranberries, dates, figs, grapes and prunes— before drying, this UNECE Code of Good Practice specifically addresses nuts and dried fruits. It contains actions and measures that public and private stakeholders are advised to take or put in place. It is aimed at strengthening the work already being done in this area by many supply-chain actors.

This Code of Good Practice sets out measures to be taken at the stages in the value chain before the nuts and dried fruits reach the consumer, i.e. from harvest to retail. It is intended to support continued improvement, step by step. Real improvement, however, can only be achieved if the food supply-chain actors cooperate to improve their logistics, handling and planning, both nationally and internationally. Therefore, communication is a key factor. Measuring loss and waste is essential, as it gives the actors feedback on how well their work progresses.

The Code consists of six distinct chapters. Each chapter focuses on a major segment of the nut and dried fruit supply chain: producers, processors, packers, traders, transporters and retailers. The retailers chapter includes a section outlining actions/practices that consumers can take to reduce waste of their dried fruits and nuts purchases. The chapters can be used individually.

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<sup>6</sup> Hanson, C., and P. Mitchell (2017). *The Business Case for Reducing Food Loss and Waste*. Washington, DC: Champions 12.3.

<sup>7</sup> UNECE (2020). *Simply Measuring – Quantifying Food Loss and Waste: UNECE food loss and waste measuring methodology for fresh produce supply chains* (ECE/TRADE/453), United Nations publication, Geneva, 2020.

<sup>8</sup> [https://sdgs.un.org/goals/goal12#targets\\_and\\_indicators](https://sdgs.un.org/goals/goal12#targets_and_indicators)

<sup>9</sup> FAO (2022). *Voluntary Code of Conduct for Food Loss and Waste Reduction*. Rome. <https://doi.org/10.4060/cb9433en>.

<sup>10</sup> UNECE (2022). *Code of Good Practice: Reducing food loss and ensuring optimum handling of fresh fruit and vegetables along the value chain* (ECE/TRADE/470), United Nations publication, Geneva, 2nd edition, 2022.

## 1. PRIMARY PRODUCERS

*Producers adhering to the Code of Good Practice undertake to do the following:*

### 1.1 Follow the principles of good agricultural, hygienic and manufacturing practices

The following principles are designed to help reduce food loss and waste:

- **Good agricultural practices:** Dedicated farm techniques, such as conventional, organic or integrated pest management principles that maximize yield, minimize losses in the field and lead to sound produce. This is a collection of principles to apply to on-farm production and postproduction processes, including good post-harvest practices resulting in safe and healthy food while considering economic, social and environmental sustainability.
- **Good handling practices:** Post-harvest handling of produce undertaken to minimize contamination, including water quality, packhouse sanitization, sanitation of containers and pest control programs.
- **Good hygienic practices:** A set of quality assurance practices to ensure that hygienic processes are rigorously set and monitored in the production of safe quality foods.
- **Good manufacturing practices:** A set of quality assurance practices to ensure that manufacturing processes are rigorously set and monitored in the production of safe quality foods.

It is highly recommended to proceed in accordance with these principles at all stages, from harvest to retail.

### 1.2 Ensure proper training of staff

Producers are encouraged to provide training in proper product handling at harvest and relevant post-harvest stages to operators. It would be particularly useful to develop handling guides per product, taking into account the operator's level of education. Operators should understand the impact of poor handling and storing practices on quality, shelf life, wastage, and on economic viability of the company/enterprise. In cases when a producer grows different varieties of nuts and/or fruits for drying, it useful to develop handling guides per product, taking into account the each product specific characteristics and requirements.

### 1.3 Plan production to demand

Production should be planned to meet market demand in terms of quantity, seasonality and quality. This means planning the production volume to the validated expected market demand (species, variety, size, colour, quality and price level). It is also important that producers consider maturity stage at harvest for fruit destined for drying, expected shelf life and type of product.

Within domestic/local markets, direct communication between producer/seller and buyer provide the producer valuable information on the buyer's preferences and demands. In value chains stretching over country borders or continents, good communication throughout chain helps convey socio-cultural and socio-economic market information – demand volume, quality, consumer organoleptic preferences – to producers.

International trade standards, which are developed with major input from the market, producers and quality inspection agencies, are commonly agreed descriptions of the market quality requirements. Therefore, the standards provide valuable information on quality requirements for

market entry. However, private commercial standards and purchase requirements may be more detailed and often have more stringent requirements from the commercial buyer.

By collecting market information and specifications, applying quality standards and applying production planning practices, producers reduce the risk of products remaining unsold at the farmgate or being rejected upon arrival at collectors/handlers, or at the wholesale or retail level.

#### **1.4 Use the best possible harvest methods**

The optimal horticultural maturity and date for each nut and fruit vary as different indices are used per product. Harvest dates depend on factors including geographical area, region, crop varieties and weather conditions. In nuts, an early harvest may result in a high proportion of small and immature nuts, while a late harvest may increase the chances of kernel germination, rancidity, microbial and fungal contamination, and insect damage. In fruits, early harvest may result in unsatisfactory organoleptic characteristics due to immaturity; late harvest results in fruit beyond their economic utility, high levels of spoilage, and increased incidence of pests and diseases.

##### ***Nuts***

The harvest method must be tailored to the characteristics of each nut, having a keen focus on product quality and shelf life. Proper equipment, harvest and practices should be applied because products can easily be mechanically damaged – cuts, bruises, tearing, breakages – which reduces their quality, shortens their storage and shelf life, and increases waste.

With the exception of peanuts, all nut harvest operations share some common elements but may vary depending on country, region, type of nut, weather conditions, farming system and farm size. For most commercially harvested tree nuts, a mechanical shaker (a machine that grasps the trunk and shakes the whole tree) is used. The nuts are shaken into a catch frame or onto the ground. Nuts that are shaken onto the ground are swept into windrows and picked up with harvesting machinery. In most agroforestry production systems, the nuts are allowed to fall naturally to the ground and then collected manually.

Unlike tree nuts, peanuts are seeds that develop underground inside pods. Their harvest is completely different from that of tree nuts. It is performed in two stages: digging and combining. A shaker lifts the plant from the ground, gently shakes off the soil from the peanut pods and inverts the plant, exposing the pods to the sun for two or three days to dry, after which a peanut combine is used to separate the pods from the vine.

Producers using mechanical harvesting methods should carefully choose and utilize equipment that does not damage products, but also assists in maintaining quality as required by consumers. Operators should be well trained. They must always be cognizant that quality of the harvested product is influenced not only by the usage of harvesting equipment but also by the experience and/or skill of the operator.

##### ***Dried fruits***

Fruits destined for drying should be harvested at their optimum horticultural stage. While some are harvested at their initial ripening stage, others are harvested at their maximum maturity stage. This practice facilitates the even ripening of the fruits in storage, the reduction of field pest damage and the maximization of yields. Fruits should always be carefully harvested and undergo post-harvest handling similar to fruits destined for the fresh market. Correct harvesting and post-harvest handling of fruits minimize quality losses from fungal attack and insect infestation.

It is very important that harvesters are trained to recognize fruits having the appropriate degree of maturity or ripeness to be harvested and differentiate between different species that may be

produced in multi-cropping systems. They should be able to recognize immature or defective fruits that are not suited for the purpose.

Harvested fruits should be carefully examined by trained operators to ensure that they are fit for further processing (ripening and drying). Immature or insufficiently developed fruits destined for drying negatively affect the colour, flavour and texture, whereas over-ripe fruits result in losses due to softness, decay, fungal disease, bruising and mechanical damage.

The best possible harvest methods need to be used for product quality and shelf life. Unless products are carefully handled and the proper equipment is used correctly, products can easily be damaged. All mechanical impact on products – cuts, bruises, tearing, breakages – will reduce their quality, shorten their storage and shelf life, and increase waste.

For mechanical harvesting of both nuts and fruits, it is very important that the equipment used that does not damage products. Also, the quality of the harvested product will be influenced not only by the way the harvesting equipment is used but also by the experience and skill of the operator.

In cases where fruits are harvested manually, staff must be trained to harvest and handle them carefully. When harvesting fruits with harvesting shears/scissors or a knife, the tool should be sharpened enough to cut through a thin layer of cells, which gives a better result than blunt edges, which damage a greater area in the cutting zone. These harvesting implements should be thoroughly cleaned and disinfected after usage. For fruits that are harvested with picking bags, these should be clean and well maintained.

#### ***Transportation and storage containers: trailers, boxes, bins, bags***

Bags, bins and boxes that are used after harvest for transportation and storage, including of fruits for ripening, should be clean and well maintained to avoid contaminating the products or introducing diseases. Ideally, they should be washed with an appropriate detergent at the end of the season or after each use if being used for different fruits and/or nuts during the season.

When nuts are transported from the field to holding/cleaning/shelling facilities directly in trailer truck loads, the trailers should be clean and checked at regular intervals to ensure they are not contaminated with vehicular lubricant or greases. Care should be taken that the trailers are not overfilled to avoid spilling the nuts during the journey from the field to the warehouse/packhouse.

Care should be taken that bags, bins and boxes are correctly filled when used for transporting and storage of fruits and nuts.

Harvesters should also be trained on how to harvest produce items at the right stage of maturity.

Raising awareness among staff and training them in the correct maintenance and use of equipment is important. For producers who do not own machines, wherever machinery is able to improve harvest results, it is recommended to consolidate among several producers.

### **1.5 Harvest products under the best conditions**

Warmer temperatures can speed the development of nuts and fruits and shorten their maturation time. Farmers face unique challenges when crops mature faster, as they have less time to pick the crops on time. In addition, crops that mature faster are often smaller, which can lead to a significant loss of revenue for growers and suppliers.<sup>11</sup>

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<sup>11</sup> <https://oehha.ca.gov/epic/impacts-biological-systems/fruit-and-nut-maturation-time>



Weather conditions at harvest can affect the post-harvest quality of products.

Important points to consider in harvesting fruits:

- It is strongly recommended that ideal weather conditions and appropriate harvest procedures should be undertaken in harvesting fresh fruit for drying. .
- Rain just before or during harvest can make fruit surfaces more susceptible to bruising.
- Fruits should be harvested in the cool of morning or late afternoon when their respiration rate is lower, which enhances quality.
- Harvest and handle fruits with care to avoid damaging them.
- Fruits should be temporarily stored in the shade while in the field awaiting transportation to the storehouse or ripening and/or drying facility.

Important points to consider in harvesting nuts:

- Rain immediately before or during harvest can make it difficult to dry nuts adequately, leaving them vulnerable to shrivelling and mould growth.<sup>12</sup>
- Do not shake/harvest tree nuts in the rain or if rain is forecasted. Tree nuts dry quicker when on the tree due to increased air circulation on the nut's surface.
- For nuts already on the ground, blow them away from the trees but not into windrows or piles to prevent them from sticking in the mud within the tree row strip.
- Do not gather wet nuts for storage purposes.

### ***Transportation***

Transportation should be adequate for the purpose intended. The conveyance should be sufficiently cleaned and maintained so as not to constitute a source of product contamination.

Sunshine, high temperatures and wind will increase water losses and speed up the ageing process. Products should therefore be taken to a storehouse as soon as possible using a means of transport that minimizes damage and maintains the quality of the products in the best possible way.

While still in the field, products need to be protected from sun, wind, rain, dust and any other factors affecting their quality, such as by being placed in covered containers or under a tree or in a shed. Humid weather makes fruit more water saturated (high turgor pressure), and this in turn makes fruit bruise more easily. For many fruits, harvesting in humid weather conditions should be avoided if possible.

Prolonged exposure to the ground should be avoided to minimize mould incidence, insect and animal damage, and deterioration. In addition, to protect against fungal infestation, healthy nuts and fruits should not come into contact with spoiled products.

### **1.6 Ensure rapid drying**

The harvested nuts and fruits should be examined by trained operators to ensure that they are fit for further processing. After harvesting, nuts and fruits can be dried under ambient conditions or by using heated air dryers before storing.

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<sup>12</sup> <https://oehha.ca.gov/epic/impacts-biological-systems/fruit-and-nut-maturation-time>

Transportation should be adequate for the purpose intended. The conveyance should be sufficiently cleaned and maintained so as not to constitute a source of product contamination.

## **1.7 Cooling**

One of the most important factors for retaining product quality after harvest is temperature. Suboptimal cool or cold chain processes and management account for much food loss. The higher the temperature at harvest and the more sensitive the products, the greater the benefit from cooling.

Fruit destined for drying gains from rapid and efficient cooling of products after harvest. If cooling is available, products should be cooled to the recommended temperature as quickly as possible without harming the product.

When pre-cooling facilities are not available, it is even more important to harvest at the coolest time of the day and to transfer the produce to a shadowed area as soon as possible.

Subtropical and tropical fresh fruits develop chilling injuries when kept at lower, though non-freezing, temperatures. Attention should therefore be paid to ensuring appropriate storage temperatures so that products sensitive to chilling are not subjected to temperatures below those that may cause chilling injury. (See annex II for recommended lowest storage temperatures for many fruits and vegetables.)

The cooling of nuts, particularly after dehusking, shelling and/or drying, is important in maintaining product quality, shelf life and safety.

## **1.8 Store products appropriately**

Both nuts and fruits should be stored appropriately after harvest and after processing.

Produce should be stabilized as soon as possible after harvesting. Post-harvest storage can last from hours to several months, and can involve on-farm or off-farm facilities.

Appropriate post-harvest conditions are important for dried fruit and nuts to prevent fungal and aflatoxin contamination.<sup>13</sup>

### ***(a) Stockpile management***

When stockpiling is used before processing, precautions must be taken to safeguard the harvest from different sources of contamination, including vertebrate pests, insects and bacteria. Moisture plays a critical role, as non-ambient moisture can be a source of contamination and can increase the potential for mould growth and aflatoxin development. Higher levels of moisture in stockpiles of some nuts may also cause internal damage.

### ***(b) Storage conditions pre-dispatch***

Prior to dispatch, products should ideally be stored at their appropriate, product-specific temperature to retain the visible quality, keeping quality and to reduce food loss and waste. This applies to products that are not shipped within a short timeframe after harvesting. The longer the storage period, the more important it is to store products at their optimum storage conditions. [To include table in annex with product specific temperatures and relative humidity]

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<sup>13</sup> Rodrigues, Paula, Armando Venâncio, and Nelson Lima. "Mycobiota and mycotoxins of almonds and chestnuts with special reference to aflatoxins." *Food Research International* 48.1 (2012): 76-90.

Common food-safety and quality concerns that might arise during the storage period of nuts and dried fruits:

<ul style="list-style-type: none"> <li>- Fungal and mycotoxin contamination (aflatoxins, ochratoxin A)</li> <li>- Growth of human pathogenic bacteria (<i>Salmonella</i> sp., <i>Listeria monocytogenes</i>)</li> <li>- Mould growth (moisture and temperature dependent)</li> </ul>
<ul style="list-style-type: none"> <li>- Rancidity (oxidation of lipids leading to off-flavours)</li> <li>- Darkening (related to initial drying temperature and subsequent storage conditions)</li> <li>- Brittleness (moisture content too low)</li> <li>- Insect infestation</li> <li>- Staleness</li> </ul>

Source: Adapted from the University of California, Agriculture and Natural Resources (UC ANR)

Nuts and dried fruits are considered non-perishable foods. However, to maintain their quality, they should be stored in a cool and dry place. It is advisable that primary producers specify optimal storage conditions on the package.

Shelf life is influenced by several factors that fall into one of three categories: product characteristics, environment and packaging. These factors interact in many ways, affecting the quality and shelf life of the product during storage.

**Major factors influencing quality and shelf life of nuts and dried fruits:**

Product characteristics	Environment	Packaging
<ul style="list-style-type: none"> <li>- Composition: moisture content, unsaturated fats</li> <li>- Water activity</li> <li>- Form: in-shell or shelled, raw/natural or dried, blanched, roasted (dry or oil roasted), cut, wholes or pieces</li> </ul>	<ul style="list-style-type: none"> <li>- Temperature</li> <li>- Humidity</li> <li>- Oxygen</li> <li>- Processing conditions</li> <li>- Insects, pests, microorganisms</li> </ul>	<ul style="list-style-type: none"> <li>- Physical protection</li> <li>- Moisture barrier</li> <li>- Gas barrier: oxygen, smells, odours</li> </ul>

Source: Adapted from the Almond Board of California’s Almond Shelf Life Factors, Technical Summary, July 2014.

Nuts should be transported soon after completion of on-farm operations to the processing facility, where they should be properly stored in ventilated silos or in bins in temperature-controlled rooms until the next stage of processing begins.

Dried fruits (not nuts) are stored stacked in bins, not in silos.

The maintenance of the quality of nuts and dried fruits during storage depends on their moisture content, the relative humidity and storage temperature, the exclusion of oxygen and effective insect controls. Whereas refrigeration is not a must, maintaining controlled conditions is crucial. Cold storage is normally not required for dried fruits and nuts stored for short periods, but can be advantageous for extended periods. High relative humidity must be avoided because it can lead to the proliferation of mould and the development of mycotoxins. [Refer to table in annex for optimal range of relative humidity and temperatures, etc]

While 0-10 °C is the recommended optimal storage temperature for kernels, in-shell nuts can be stored at a slightly higher temperature (8-18 °C).

In-shell nuts also have a 25-50% longer shelf life than kernels. Depending on the specific nut and if the packaging provides a moisture barrier and/or low oxygen concentration, this percentage can vary significantly.<sup>14</sup>

Dried fruit stored between 4-20 °C and at around 65% relative humidity can maintain optimal quality for a period of approximately one year. Temperatures below 10 °C prevent mite growth. Temperatures that are too low result in candying because of the crystallization of glucose. At temperatures higher than 25 °C, chemical reactions happen rapidly, which may lead to considerable syrup formation and self-heating.<sup>15</sup>

Although refrigeration or freezing temperatures do not reduce the microbial population, low temperatures hinder the growth and multiplication of most microbes, and particularly aflatoxins, in nuts.

During storage, products should be kept away from any items that have strong smells or odours, and should be protected from rain, insects and other pests. Sanitation practices for pest management include cleaning the areas that come into contact with food, good waste management, appropriate maintenance of the storage areas, sealing cracks and holes, and practices to reduce pest attraction.

Low oxygen levels (<1%) are very effective in delaying rancidity, staleness and other deterioration symptoms.<sup>16</sup> The exclusion of oxygen is usually achieved by vacuum packaging or by nitrogen-flushing the package.<sup>17</sup>

The use of controlled atmosphere (CA) storage technology can greatly extend the durability of products and reduce losses. Additionally, conditions such as levels of oxygen, humidity and carbon dioxide need to be closely monitored for all products.

When refrigerated storage is not available, products should be kept at the best possible conditions and protected from sun, rain, wind and dust. If products are kept outside, a clean tarpaulin can provide some protection. Condensation and moisture favour mould development. Therefore, storage facilities must be dry, well-ventilated, provide protection from the weather, and minimize temperature fluctuations.<sup>18</sup>

Because of their high concentrations of unsaturated fatty acids, nuts may sustain oxidative rancidity during storage, which results in undesirable off-flavours and off-odours. The characteristics of the packaging material used influences the oxidation process. For example, gas-impermeable packaging materials reduce the available oxygen, preventing rancidity.<sup>19</sup>

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<sup>14</sup> Cantwell, M. (2014). *Estimates of Shelf-life of Raw Nuts Held at Different Temperatures*. University of California, Davis. <https://postharvest.ucdavis.edu/publication/estimates-shelf-life-raw-nuts-held-different-temperatures>

<sup>15</sup> BMT. (n.d.). *Fruit, dried*. CargoHandbook.com. [https://www.cargohandbook.com/Fruit,\\_dried#:~:text=Dried%20fruit%20should%20be%20stowed,one%20year.](https://www.cargohandbook.com/Fruit,_dried#:~:text=Dried%20fruit%20should%20be%20stowed,one%20year.)

<sup>16</sup> Maté, J. I., Saltveit, M. E., & Krochta, J. M. (1996). Peanut and walnut rancidity: Effects of oxygen concentration and relative humidity. *Journal of food science*, 61(2), 465-469.

<sup>17</sup> Harris, L. J. (Ed.). (2013). *Improving the safety and quality of nuts*. Elsevier.

<sup>18</sup> Codex Alimentarius. Code of Practice for the Prevention and Reduction of Aflatoxin Contamination in Peanuts (CAC/RCP 55-2004).

<sup>19</sup> Harris, L. J. (Ed.). (2013). *Improving the safety and quality of nuts*. Elsevier.

## 1.9 Choose appropriate packaging and label correctly

To protect products during transport and distribution, appropriate packaging needs to be used. The quantity and quality of packaging material should ideally be balanced to ensure sufficient protection, buyer requirements and environmental concerns.

Packaging is often chosen as the result of a dialogue between seller and buyer. The wish to fill packages and thereby use space in storage and transportation efficiently should be weighed against the risk of causing damage to the products when packages are put on top of each other on a pallet.

The quality, strength and characteristics of the packages should be sufficient to protect the produce during transport and handling. Clean materials should be used to protect the produce from foreign matter such as leaves, sand or soil, which could negatively affect the produce and its presentation. A visible lack of cleanliness in packages could result in the goods being rejected.

Durable reusable crates, which should be cleaned, can be used between actors with a long-term business relationship if an exchange of full and empty crates is feasible. This ensures the continuous use of suitable packaging.

Bulk containers as well as consumer packages must be labelled according to the requirements of the country of destination. Incorrect marking is one of the main causes of the rejection of produce by inspectors and can become the cause of loss and waste. Incorrectly labelled boxes may be re-labelled at the discretion of the inspection agency. The re-labelling of consumer packages is often considered tedious and too costly. When products are packed and labelled for a buyer's private label, in cases of returned or cancelled orders it is not permitted to sell the products to another buyer unless the products are repacked.

## 1.10 Stack bins and boxes appropriately

Placing packages on pallets and not directly on the floor in storage:

- facilitates effective cold storage through air circulation
- enables the ease of handling through the use of machinery for loading and unloading
- contributes to sanitary conditions in storage and helps address consumer food safety concerns.

Non-retail produce containers (cardboard cartons, boxes, crates, bins, sacks, bags, etc.) should be stacked correctly, not exceeding individual container stacking strength. The stacking strength determines how much weight a package can bear and therefore how high it can be stacked.<sup>20</sup> Handling staff should adhere to worker safety rules relating to stacking limitations in the country of operation.

Over-stacking or under-stacking pallets have cost implications for the trader and retailer.

Under-stacking of pallets may result in:

- less efficient use of storage space
- increased risk of mixing non-compatible produce
- errors in stock management, particularly when pallets are counted instead of containers.

Over-stacking of pallets may result in:

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<sup>20</sup> Stacking strength indicates the container's resistance to crushing (and thus protection of its contents). It is built into carton sidewalls and influenced by the size and type of carton material used. The strength is sometimes printed on the carton.

- crushing of the packages at the lower level, damaging the produce and leading to food waste and financial losses
- difficulty in handling by staff (manually and with equipment such as pallet jacks and forklifts)
- posing direct threats to the health and safety of the workers who may have problems reaching the top levels or difficulty seeing around the stack (when using a forklift, for example), or risk of the stack falling over
- inability to re-use cardboard boxes and plastic crates due to damage
- breaking of pallets.

### **1.11 Post-harvest treatments may be considered**

Post-harvest treatments to increase shelf life and reduce losses and waste are available for both organic and non-organic production of nuts and dried fruits. When used, they must be authorized by the producing country and the country of destination. Therefore, the treatments must be carefully documented.

Post-harvest treatments have several positive effects, such as restricting pest damage and the presence of pests. The treatments can also lengthen shelf life and increase consumer acceptance, thus potentially avoiding both immediate and future losses.

Post-harvest treatments can include fumigation, which is an effective method of eliminating insects in stored commodities.<sup>21</sup> Fumigation may involve the use of hazardous substances which are strictly regulated in most countries.

### **1.12 Record parameters affecting quality**

Parameters that affect quality include temperature, humidity, harvest time, transport to packing house, grading, packaging and storage. These should be monitored and recorded for easier traceability and implementation of corrective measures. They should be recorded per handling stage and for every shipment.

### **1.13 Report outbound quality**

Reducing waste in the global food chain starts by supplying the appropriate quality into the system. It is recommended that producers create “outbound quality-control reports” that mirror the quality demands of their clients – i.e. know what critical quality parameters the client monitors and check the same (with photographs) when the product is ready for dispatch. This allows for corrective measures to be taken prior to departure or warning the client to know what to expect and avoid rejections.

### **1.14 Find alternative outlets**

Not all of the crops produced will meet the requirements specified by the buyer. Good communication between buyers and sellers is therefore important to know what the buyer expects and to increase the buyer’s understanding regarding certain defects. It can raise an interest in the buyer for selling products with exterior defects as for example “rescued produce” in order to contribute to reducing losses and waste. If products are sold in quality categories, a lower category will often accommodate most of the products with exterior defects thanks to the higher tolerances in lower categories.

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<sup>21</sup> Bell, C. H. (2000). Fumigation in the 21st century. *Crop protection*, 19(8-10), 563-569.

Producers should have in place alternative outlets and uses for products that cannot be placed on the intended market and/or sold to the intended buyer.

The following alternatives are examples that might be considered:

- Find alternative outlets, new markets or destinations, primarily for food uses, such as ingredients in the confectionery, bakery and ice cream industries, alternatively as paste, flour, drinks, oils, skincare products, etc.
- Change presentation to address new market segments.
- Find buyers that can process (industrially) for food purposes.
- Find buyers that can process into novelty products.
- Process products on-site to address new market segments.
- Donate to charity, respecting applicable guidelines.<sup>22</sup>
- Use surpluses for economic uses such as animal feed.

If products cannot be sold to the “normal” buyer in a lower category or as “rescued produce” or equivalent, the alternatives set out above can also be considered.

### **1.15 Measure the losses**

Primary producers and others involved in food production that understand the causes of food waste and measure it have a greater capacity to reduce waste at the source. This implies that most acknowledge the problem, measure the loss, identify hotspots and manage the food losses through targeted interventions. Those that regularly measure waste can identify more easily the hotspots for this waste (where it happens) and review the results to start a learning process. This is a valuable tool for finding measures that lead to reduced waste.

The results can be used not only for future planning but also for implementing measures related, for instance, to cultivation, handling, temperatures, transport and logistics. Apart from the aspect of reducing waste, there is a strong business incentive to carry out this work.

### **1.16 Support local government interaction**

Communicate waste data to the local government or agricultural office. This information opens opportunities for public measures (e.g. redistribution of surpluses into shortage areas).

\* \* \* \* \*

## **ANNEX I**

Estimate of months of shelf life of raw nuts (in-shell and kernel) at different temperatures  
> to replace with table with product-specific temperatures and relative humidity  
(*optimal range of relative humidity and temperatures, etc*)

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<sup>22</sup> The EU guidelines on food donation are one example [https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52017XC1025\(01\)](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52017XC1025(01))