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**STRENGTHENING INSTITUTIONAL CAPACITY OF
MINISTRY OF TRANSPORT AND INFRASTRUCTURE
ON THE TRANSPORT OF PERISHABLE FOODSTUFFS**

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***Needs Assessment Report on the Implementation of the
ATP Agreement in Fresh Fruits and Vegetables***

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PREFACE

Despite the fact that Turkey is in the leading position in the world's fresh fruit and vegetable production due to its fertile and wide agricultural areas suitable for production and the ecological differences of different regions, the ratio of exports to production remains low in comparison to its potential. In this sector, which has a key position in terms of both human health and our economy, production is carried out under difficult conditions, and since the product is a perishable commodity, its export is also carried out under difficult conditions. For this reason, in order to prevent very high losses during transportation, storage, packaging, preservation and sales points in vegetables and fruits during harvest and post-harvest periods, the collection of all these stages under the cold chain is of vital importance both for the sector and the consumer.

In these markets, where non-tariff barriers distort competition and considerations such as food safety and quality are becoming increasingly important, the ability to deliver products to consumers without breaking the cold chain has become a prerequisite for the development of our exports.

Rather than sending low-quality fresh fruit and vegetables to markets at low costs, it is possible to add a strategic dimension to the sector by adopting approaches to marketing products that have gained shelf life in supermarkets. It should be a prerequisite for the products to be delivered to the consumer without breaking the cold chain.

With the ATP agreement, to which Turkey is also a party, perishable foodstuffs must be transported in a healthy way through the cold chain, both in the domestic market and in international transportation. Refrigeric vehicles, cold storage, etc. must be made mandatory within the framework of the ATP agreement.

1. TURKISH FRESH FRUIT AND VEGETABLE MARKET

1.1 CURRENT SITUATION

One of the most important sub-components of the agricultural sector is the fresh fruit and vegetable sector. These products are marketed by the private sector in Turkey. In the marketing channel from the producer to the consumer, brokers, traders and retailers are usually involved. Fruits and vegetables are generally products that do not have storage opportunities, have high input costs and labor needs. In this process, the prices of the products vary depending on the costs. "Market Margin" refers to price variations that occur during the product's marketing period.

Despite the fact that Turkey is in the leading position in the world's fresh fruit and vegetable production due to its fertile and wide agricultural areas suitable for production and the ecological differences of different regions, the ratio of exports to production remains low in comparison to its potential. In this sector, which has a key position in terms of both human health and our economy, production is carried out under difficult conditions, and since the product is a perishable commodity, its export is also carried out under difficult conditions. Turkey is a country that has a say when it comes to world fresh fruit and vegetable production. We have a geography suitable for agriculture, hardworking farmers and professional chambers that are competent in their subject. While it is the world's leading producer of hazelnut, sour cherry, and cherry, it is the world's second-largest producer of melon and watermelon, third-largest producer of apple, and fourth-largest producer of tangerine. Turkey is the 4th largest vegetable producing country in the world. It has a volume of 31.2 million tons in vegetable production and 23.6 million tons in fruit production. Food loss is a significant issue in Turkey, as it is in all underdeveloped countries. Food loss is mostly seen in the fresh fruit and vegetable sector, followed by ready meals and bread. It is observed that food loss in Turkey mostly occur in the early stages of the supply chain. It has been determined that the amount of lost product in 51 wholesale businesses located in 23 provinces is 0-10% of the total product amount received by the wholesale market¹. 60% of wholesale markets' infrastructure is inadequate.

When the structural sizes of the wholesale markets are examined, it is observed that they are between 160 m² and 2250 m². It is seen that the majority of wholesale markets do not have cold storage rooms, and those that do do so do not have enough capacity. When the reason why the products do not come with frigorific vehicles is investigated, it is concluded that the costs of frigorific vehicles are high. When the products with the highest loss of 40% or more were investigated, it was revealed that these were peach, strawberry, mulberry and green leafy vegetables².

1.2 TRADE OF FRESH FRUIT AND VEGETABLES

Approximately 7% of the fresh fruits and vegetables that we produce are exported. According to the data of Alata Research Institute, post-harvest losses occur in fresh fruits and vegetables between 5-25% in developed countries and 25-50% in developing countries. 4-12% of these losses occur during harvest, 2-8% during transportation, 5-15% during preparation for the market, 3-10% during storage and 1-5% during consumption³.

The first condition for a long post-harvest shelf and storage life in fresh fruits and vegetables is the quality of the product coming from the garden. It is of great importance to comply with the harvest rules, and not to break the cold chain during the post-harvest transportation, processing, storage and sales stages.

Factors affecting post-harvest losses may differ from place to place. To minimize losses, appropriate post-harvest technology should be implemented throughout the supply chain. Fruits and vegetables are living tissues that continue to respire and lose water after leaving the plant stem. These are the main biological processes that can affect post-harvest quality and losses. In addition, the degree of maturity should be considered. Post-harvest

¹ Fruit and Vegetable Workshop, Konya 12-13 June 2019 / Selçuk University, TAGEM

<https://www.tarimorman.gov.tr/TAGEM/Belgeler/Duyurular>

² Vegetable and Fruit Production in the World and in Turkey, Ankara 23.01.2017 / Ankara Commodity Exchange
https://www.ankaratb.org.tr/lib_upload

³ Competitive Production in Agriculture and Food, Ankara 2018 / Ministry of Development 11th Development Plan
<https://www.sbb.gov.tr/wp-content/uploads/2020>

product quality is affected by many factors that determine or change the size, external and internal qualities and storage adequacy of the plant product. Post-harvest processing does not improve fruit quality; rather, it preserves the existing quality from the field.

Breaking the cold chain during transportation, improper packaging and stacking, errors during processing, proper storage temperature for the product, failure to comply with appropriate humidity rules, impacts during processing, storage and transportation temperature of the product, and storage of the product with different products are all factors that affect the quality after harvest.

In summary, the three main elements in the journey of fresh fruits and vegetables from the branch to the table are as follows;

1. Packaging
2. Storage
3. Transportation

The main parts of an integrated cold chain are:

- Packing and cooling of fresh food products,
- Food Processing (eg. freezing of some processed foods),
- Cold Storage (short-term or long-term storage of frozen foods),
- Distribution (frigorific transportation and temporary storage in temperature controlled conditions)
- Marketing (putting the product in refrigerators or freezer storages and window displays in wholesale markets, retail markets and food service business)

1.3 MARKETING OF FRESH FRUIT AND VEGETABLES

Producers operating in the agricultural sector are generally small businesses with limited marketing opportunities. These limited opportunities can be eliminated thanks to the effectiveness of marketing channels, and manufacturers can easily reach markets other than local markets. The marketing system of agricultural products in Turkey differs from product to product. While public institutions and cooperatives are involved in the marketing channels of some products, the system mostly relies on the private sector.

Producer markets are markets where the product is also sold by the producer, in other words, where the producer sells his product.

A wholesale market is a market where the product is bought from the manufacturer by the collectors and sold to other buyers such as processing plants and large wholesale markets.

Retailer markets, on the other hand, are supermarkets, greengrocers, grocery stores, etc., where the products purchased from wholesale markets or other intermediaries reach the consumer, and in other words, where the product is purchased by the end consumer.

The concept of agricultural marketing covers all the activities in the process, starting with the quantity and quality of the product to be produced by the producer, preparation of the product for the market, standardization, storage, transportation and finally reaching the consumer.

The marketing system differs according to the structure of the product, while non-public marketing organizations are generally valid for fresh fruits and vegetables and ornamental plants, products such as hazelnuts and tea are marketed within the system through cooperatives and traders. Due to the structure of the product, some products can be included in a whole system, while some products can be included in a variety of marketing channels.

Contracted and certified production systems will contribute greatly to the solution of problems in the marketing of horticultural products. The transition to contracted agriculture and certified products will make significant contributions to both the country's economy and the protection of natural life.

Certified Product: It refers to a product that has been produced under the control of an independent institution authorized to issue certificates during the period from sowing to harvest, in accordance with previously established norms.

Certified production models:

The organic farming model is an agricultural production and processing method that combines best environmental practices with more natural production processes.

The good agricultural practices model is the type of agricultural production made in order to make production that does not harm the environment, human and animal health, to protect natural resources, to ensure traceability and sustainability in agriculture and food safety.

The Eurogap model (European model of good agricultural practice) is a documented procedure for identifying registered products and ensuring the traceability of all products both conforming and not conforming to applicable production sites. The area where the products are processed (for vegetables and fruits) are the procedures that ensure that the registered products are identifiable and traceable from the moment they are received, to processing, storage, distribution. The Eurogap document, which has become a prerequisite for the export of fresh fruits and vegetables to European Union countries, is a product monitoring assurance provided by European Union (EU) retailers to their consumers.

Since the participation of the producers in the marketing of fruit and vegetable products is low in Turkey, the producer can only be paid half of market pricing. The increase in the number of intermediaries in marketing channels causes the share of producers to decrease even more.

Contract farming is defined as an agreement-based production and marketing model between companies and producers prior to the planting, planting or production of the product, in which the farmer is responsible for carrying out a certain cultivation area and production, and the companies guarantee to receive the product to be obtained under certain conditions.

1.4 FACTORS AFFECTING THE DETERMINATION OF SALES PRICES

- Natural factors,
- Seed, fertilizer and fuel prices,
- Cold chain and storage costs,
- Supply-demand equilibrium
- Consumption amount of markets,
- The amount of the product produced and presented to the market,
- The income level of the consumer in the market,
- Prices of similar (alternative) products in the market in the same period,
- The habits and tastes of the consumer in the market,
- Different ways of making use of the product,
- Advertising of the product.

1.5 DOMESTIC FRESH FRUIT AND VEGETABLE TRANSPORT INDUSTRY

87.4% of intercity freight transport in Turkey is carried out by road⁴. The importance given to fruit and vegetable transportation in Turkey, which is one of the most important fresh fruit and vegetable producers in the world, is increasing day by day. Low prices and a cold chain are especially vital in the transportation of fresh fruits and vegetables, where time and fuel savings are important. Food is a living product and the risk of wastage is very high. This risk is higher in fresh fruits and vegetables compared to all other food products. Maintaining the quality and quantity of the product throughout the process from the first production to the consumer is also critical in fresh fruit and vegetable logistics. Fresh fruits and vegetables that cannot be stored should be transported to the sales point immediately when harvested and brought to the consumers.

Especially in the last period, there are major problems in the sector, especially in agriculture and food logistics since the harvest period of these products and the delivery of the product to the consumer after the harvest is always carried out in a race with time. The vast majority of domestic fresh fruit and vegetable transportation in Turkey is carried out without a cold chain, and a one-day disruption can cause serious losses in products.

As domestic production areas move away from consumption centers, logistics costs increase and fuel prices, bridge and highway tolls bring a significant cost to the prices of agricultural and food products we consume. In export, the problems experienced in the supply of containers increase the rental expenses day by day. Furthermore, container ships cannot go to major European ports. Since time is very valuable in the fresh fruit and vegetable trade, air freight has an important share as a preferred logistics method.

In the sector, where almost 50% losses from the field to the consumer's table occur, it is important that the cold chain system is implemented in the entire fresh fruit and vegetable sector in order to eliminate these losses⁵. To prevent product loss and extend its shelf life, a proper feasibility study should be carried out in order to switch to the cold chain system from the production stage until it is presented to the consumer.

1.6 LOSSES

In order to define the losses well, the difference between food waste and food loss should be thoroughly examined. In its 2021 report "Food waste in Europe: statistics and facts about the problem" EUFIC defined it as:

Food loss: It refers to any food that is discarded, incinerated or otherwise disposed of along the food supply chain from harvest/slaughter/catch up to, but excluding, the retail level, and is not used for any other productive use, such as animal feed or seed.

⁴ The Journal of International Social Research/HISTORICAL PROGRESS AND CURRENT STATE OF HIGHWAY TRANSPORTATION IN TURKEY WITH RESPECT TO TRANSPORTATION GEOGRAPHY, Issn: 1307-9581 Erol Kapluhan
<https://www.sosyalarastirmalar.com>

⁵ Competitive Production in Agriculture and Food / Specialization Commission Report, Ankara 2018 / Ministry of Development 11th Development Plan
<https://www.sbb.gov.tr/wp-content/uploads/2020>



Photo 1 Waste Fruits and Vegetables (Food waste)

Food waste: It refers to food that is discarded at the level of retailers, food service providers and consumers. Food is wasted in many ways, for example;

- Fresh produce that deviates from what is considered optimal (e.g. size, shape or color) and is removed during sorting actions.
- Foods that are discarded by retailers or consumers when it's close to or beyond the best before date.
- Unused or leftover food that is thrown out from households or restaurants.



Photo 2 Wasted Food (Food waste)



Figure 1 Food Loss and Food Waste Occurrence Locations

1.6.1 Causes of Losses

Most of the losses experienced until the agricultural products reach the end user are due to the following reasons (TÜSİAD, 2020):

- Incorrect practices in harvesting methods,
- Failure to protect the product from climatic conditions,
- Occurrence of jolting-squeezing-puncture-impact damages as a result of improper packaging,
- The fact that no cooling is applied in products that require pre-cooling,
- The fact that the products do not comply with the quality standards,
- The excess of handling (repackaging, unnecessary transport etc.) operations that do not create added value,
- Not storing the product in the right conditions,
- Using the wrong means of transport.

1.6.2 Loss Rates

According to the IMPROVEMENTS IN AGRICULTURE AND FOOD LOGISTICS report published by TÜSİAD in 2020 and FAO data based on 2013, losses in the supply chain are based on 33%. 40% of losses in underdeveloped and developing countries occur in logistics processes (storage, transportation and packaging), and 40% of losses in developed countries are in retail and consumption processes (FAO, 2013).

Highlights of EUFIC's 2021 report are⁶:

- Approximately one-third of all food produced for human consumption is lost or wasted.
- Food waste alone accounts for about 8% - 10% of global greenhouse gas emissions.
- Approximately 931 million tons of food waste was produced in 2019 and their distribution is;
 - %61 domestic waste
 - %26 restaurant and catering
 - %13 retail
- About 88 million tons of food waste is produced annually in the EU.
 - 174 kg per person
 - 143 billion Euros
- Levels of food waste are similar in high-, upper-middle- and lower-middle-income countries in Europe.

In the detailed report of the UN in 2020, many countries in the world were examined, however, in this research, it was stated that the data about Turkey was not very reliable and that the annual household waste was 93 kg per person. The distribution of food waste is as follows, in the light of reliable data solely from high-income countries, where even majority of the available information is unreliable. Assuming that Turkey is also in this group, we can base similar rates.

Table 1 Average Food Waste According to the UN (2020)

Average Food Waste (per person per year)		
Domestic	Food Service	Retail
67-79%	22-26%	11-13%

⁶ EUFIC 2021 Report <https://www.eufic.org/>

As can be observed from all these loss studies, the loss of fresh fruits and vegetables in packaging, storage and transportation is between 11-13%⁷. In all this loss, only the effect of transportation could not be seen, and no specific study could be found.

- These studies have not been carried out in terms of fresh fruit and vegetables, however, in general, similar statistics can be used. Considering this, it will be seen that the main loss in fresh fruit and vegetables is not in logistics, but in homes and restaurants.

According to the data obtained from Akdeniz University Faculty of Agriculture, Department of Horticulture, product-based post-harvest loss rates are listed below⁸.

Table 2 Post-harvest loss rates

Developed Countries	
Product	Loss Rate %
Green salad, Iceberg lettuce	11.7
Cucumber	7.9
Sweet Pepper	10.6
Potato	4.9
Apple	1.7
Peach	2.6
Strawberry	22
Orange	10-12
Tomato	14.7

Developing Countries	
Product	Loss Rate %
Lettuce	62
Cabbage	37
Cauliflower	49
Tomato	20-50
Onion	16-35
Potato	5-40
Apple	14
Peach	28
Grape	20-95
Citrus	23-33
Banana	20-80

As it can be understood from the difference between the two tables, the amount of losses increases to a great extent due to the infrastructure inadequacies in pre-cooling, storage and distribution in developing countries, although the values given in the tables cover very few fruits and vegetables.

⁷ Improvements in Agriculture and Food Logistics, March 2020 TÜSİAD-T/2020-03/617 Prof.Dr. Arzu Tektaş, Prof.Dr. Mehmet Tanyaş

⁸ Storage and Preservation of Horticultural Products / Akdeniz University, Faculty of Agriculture, Department of Horticulture Prof.Dr. Mustafa Erkan

<https://www.sorhocam.com/uploads/docs/bahce-urunlerinde-depolama-ve-muhafaza-94560.pdf>

2. PACKAGING, STORAGE AND TRANSPORT OF FRUIT AND VEGETABLES

2.1 PRE-PROCESS AND STAGES

After the fruits and vegetables are harvested, they must go through different processes and stages before being put into storage. While some varieties of vegetables and fruits have good quality, they may not be suitable for preservation methods. For this reason, the suitability of the raw material for the purpose should be determined beforehand. When stored under suitable conditions, harvested fruits and vegetables retain their fresh qualities to a great extent. Suitable conditions are provided by adjusting the temperature and humidity. Every fruit and vegetable has a certain temperature and humidity at which it can be best stored. Even the optimum storage requirements of the same fruit and vegetable may differ depending on the variety and the conditions of the region where it is grown. Additionally, no matter how well the conditions are provided in storage, every fruit and vegetable only lasts for a certain period of time. This period can vary from a few days to 5-6 months.

The harvest time of vegetables and fruits is also important in terms of product quality. Vegetables should be harvested when they are tender and when fruits reach their unique flavor, aroma and color. However, ripening and maturity may differ.

The harvested product should be brought to the factory and processed quickly under the most suitable conditions without waiting too long. The quality of vegetables and fruits changes negatively in the time passed without processing. However, the product is subjected to a variety of processes during processing and may be exposed to storage diseases during this process. These stages are:

Product Transport Mechanisms

Various transport mechanisms are used for purposes such as ensuring the passage of the harvested product between the lines and transporting the raw material to vehicles of different heights.

Washing the Product

Before washing, the soil of vegetables and fruits should be removed. The removal of the soil facilitates the washing process. Washing is the first process applied to vegetables and fruits taken to the factory. Washing is applied to remove foreign materials such as dust and soil, to remove pesticide residues and to alleviate the microorganism load on the raw material surface. Businesses mostly perform the washing process in 3 stages.

Prewash - Wash – Rinse

Pre-Wash: It is used by businesses that prefer to transport the product to the factory with water flow. The pre-washing process is performed simply by immersion in water.

Wash: This process is carried out by considering the characteristics of the raw material with the help of various machines.

Rinse: Regardless of the method used to wash vegetables and fruits, they are finally rinsed by spraying water with the help of a shower device while being transported on a belt or elevator. With rinsing, the previous washing water residues are removed.

Clean and cold water should always be used for washing. In businesses, washing water can be chlorinated at a level of 0.5–2 mg/l active chlorine. In this way, the microbial load of the washing water and the product is reduced.

The main washing step of vegetables and fruits is usually carried out by moving them in water with different systems. An effective washing can be achieved in the agitated water by moving the water in the tank with the help of pallets or by giving compressed air to the water in the tank. With the agitation of the water, foaming can be seen, especially if chlorine is added to the water.

In washing machines, washing is done by showering, that is, by spraying water. The use of pressurized water and the closeness of the spray nozzles to the raw material provide better washing.

In brush type washing systems, the raw material is taken between the brushes and washed with the water in the tank and transported forward. Potatoes, cucumbers and citrus fruits can be washed effectively with this system.

Sorting

Vegetables and fruits should be sorted immediately after washing since the defects of washed vegetables and fruits are better noticed. Damaged, dented, rotten and moldy, unsuitable raw materials are completely discarded. Sorting is usually done manually.

Classification-Sizing-Grading

Vegetables and fruits are classified after sorting. Thus, those with the same characteristics are divided into different groups. The main purposes of classification can be listed as follows:

Seeing the vegetables and fruits in the package with the same characteristics and size affects the consumer positively. In terms of standards, there is a requirement. It ensures adequate heat treatment. Classified products can be placed on the market at different prices. Classification can be done before or after processing, depending on the raw material property and storage method. For example, peas are sorted before canning, while strawberries are sorted after they are frozen.

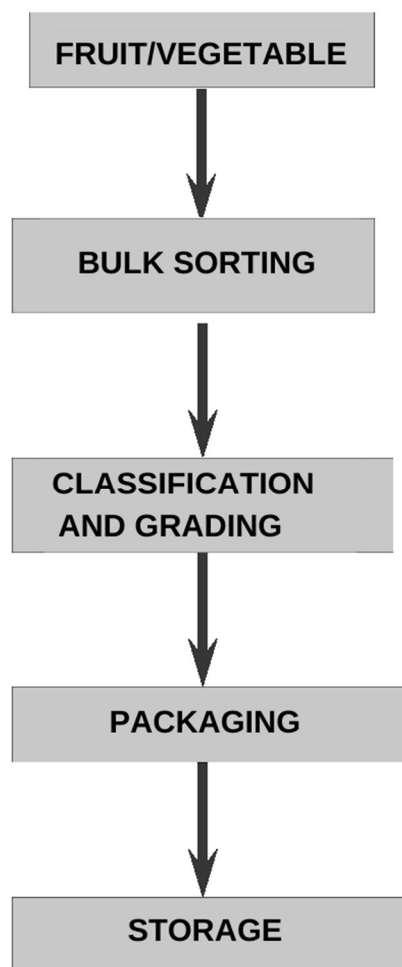


Figure 2 Packaging Stages (summary)

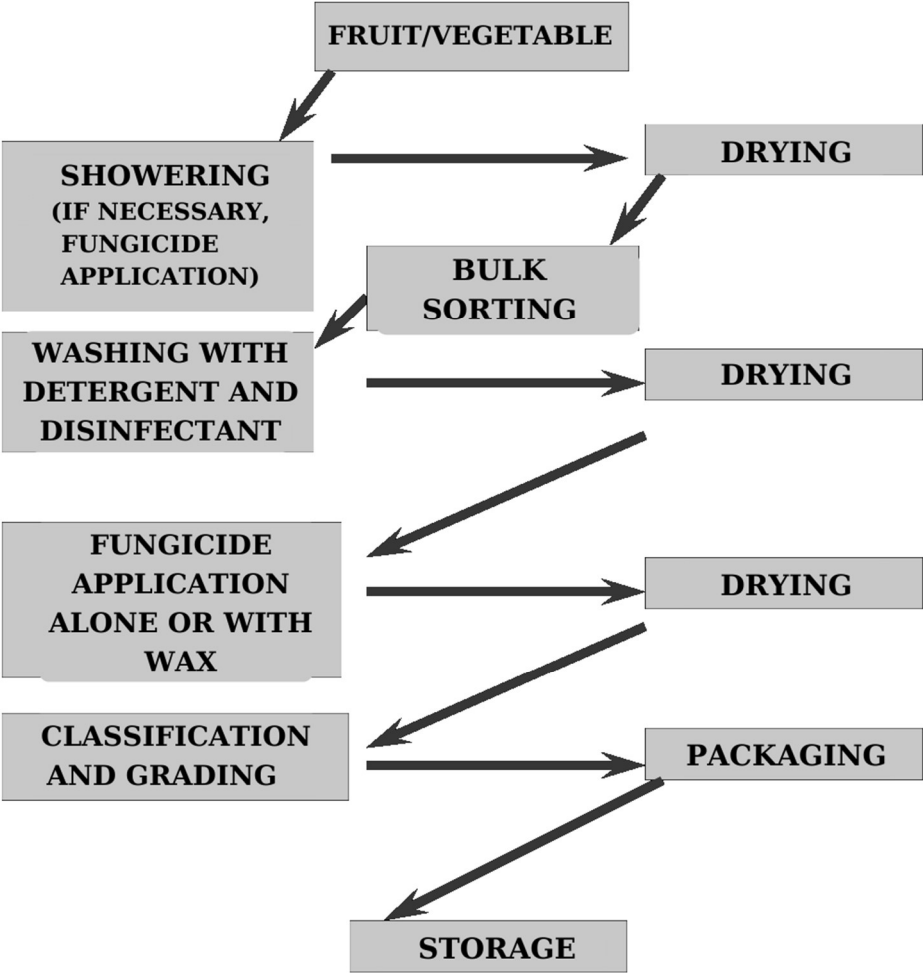


Figure 3 Packaging Stages (in detail)



Photo 3 Citrus Packaging Plant



Photo 4 Citrus Packaging Plant

2.1.1 Packaging

One of the important elements to prevent spoilage and damage to fruits and vegetables is packaging. Packaging standards are usually included in the contracts between the buyer and the supplier. In cases where it is not, packaging options accepted as standard in the market are used.

Packaging of products has two purposes, the first is to increase the attractiveness of the product and the second is to ensure that it maintains its quality. Similar to the precautions taken in order not to break the item sent in an ordinary cargo shipment, it should also be taken when it comes to fresh fruit and vegetable packages.

A package is expected to protect the product inside and its structural integrity under the following conditions:

- Rough handling during loading and unloading
- Compression/pressure from the top weight of other containers
- Shock and vibration during transportation
- High humidity during pre-cooling, transportation and storage.

Vegetables and fruits can also be transported in a pallet box, in sacks, in cardboard boxes, in tied bundles or in bulk (into a truck box), depending on the type of product and processing method. For example, tomatoes to be processed into paste are transported in bulk in trucks or trailers. Tomatoes to be processed for canning or freezing are transported in plastic crates. Tomatoes to be processed for canning or freezing are transported in plastic crates. In terms of hygiene, transportation in plastic crates has become widespread in recent years.

Vegetables and fruits are mostly transported in crates with the transport vehicles listed above. Businesses send the plastic crates to collection centres, contract farmers or middlemen. These crates are used in the transportation of products. They are available in various sizes and weights. Besides crates, plastic boxes are also used, which are of the same material but larger in size. It is used to transport vegetables and fruits that are not very sensitive, such as cauliflower, broccoli, cabbage, citrus, etc. The bottoms are designed as pallets in order to facilitate transportation and stacking. Mesh sacks are used in the transportation and marketing of some vegetables (onion,

potato, carrot, cucumber, eggplant, beans and pepper) and fruits (lemon, squeezed orange, etc.). The raw material of mesh sacks is polypropylene. Mesh sacks range in width from 45 to 70 cm.

For example, wooden crates of 8-10 or 13-14 kg, telescopic cardboard boxes of 10-12 kg or open cardboard boxes of 10-12 kg are used for apples. Cardboard boxes must have 5 layers in order to protect the products against temperature fluctuations, vibrations and impacts.

For table grapes, 8 kg plastic boxes, 5.8 or 10 kg telescopic cardboard boxes or 5-8 kg closed cardboard boxes are preferred, and the grapes are wrapped in cold weather.

Peaches are transported in wooden boxes of 4 kg or cardboard boxes of 7-8 kg.

While cherries are transported in 4 kg plastic, cardboard or wooden boxes, it is considered appropriate to wrap them with a film.

Although much more elegant packaging adds visuality, its durability and how effectively it can protect the products are more important than such packaging methods.

The consultant's opinion is that the average waste rate of fruits and vegetables in the package is halved. Thanks to the reasons such as the controlled moisture loss of the packaged products while in the appropriate packaging, the minimum human intervention, being more protected from external factors during storage and transportation, protection from impacts, the rate of decay of the products decreases while the moisture loss is controlled, which reduces the waste rate and is also beneficial for preserving the flavor.

Reducing hand contact is also a crucial issue in terms of hygiene and public health by reducing the transmission of diseases between people. In the first days of today's pandemic COVID-19, one of the first measures taken was the display and sale of fruits and vegetables in packaged form. However, our habits have also overcome the fear of disease, and products have been taken out of their packages and started to be sold in the open again.

The packaging group, which has a wide range of options from cardboard plates, foam plates, stretch films, perforated packaging films, stretch wrap machines to flowpack packaging machine (horizontal packaging) and tray sealing machines for every product type and need, will reduce the waste of retail businesses and increase their profit rates, as well as for us as consumers it will allow us to reach the products more economically since the cost of each product thrown away is added to the product we buy.

Considerations in Packing Houses

The buildings where the packing processes are carried out in the preparation of vegetables and fruits for the market are called packing houses.

In the packing houses, the products of various gardens with different characteristics are prepared in accordance with the standards and presented to the consumers at the appropriate time and market conditions. In the design of the packing house;

- Selection of location,
- Equipment
- The type of product to be processed should be considered.

Units required in packing house:

- An area where the products from the garden are kept temporarily,
- Pre-cooling room and cold storage,
- An area where the product is processed (washing, sorting),
- Ripening and yellowing rooms,
- Auxiliary material warehouse (empty packaging, labels, etc.),
- An area where the ready-to-market product is stored,
- An area where office work and social needs of workers are met.

Additionally, tools and assemblies are required for the proper handling of the product, forklifts, trolleys and various conveyors are required for loading, unloading and stacking. In the packing house, the entrance, exit and workflow between the units should be well planned.

Lighting is done with diffuse sunlight, however, natural fluorescent light is also used. Working areas should be painted in a light color, and the temperature should be 12-15 °C so that the product does not get hot and the workers can work efficiently. Plants should have high standards in terms of hygiene and cleanliness.

Packaging in the food industry is a tool that ensures that the products put in it are delivered and promoted to the end consumer in a safe manner, without spoiling, at the least total cost.

Functions of packaging;

- Protecting the product inside,
- Increasing the durability of the product,
- Providing ease of loading, unloading, stocking and use,
- Promoting the product and encouraging the consumer to buy.

A good packaging material should have the features mentioned below:

- It should keep the product clean and prevent the food from contamination and other impurities.
- It should keep the nutrient losses at the lowest level.
- The design of the packaging should protect during transportation, distribution and while it is kept on the shelf and should be in a way that it can be held easily by the hands. The shape, size and weight of the packaging are important. It must retain the original shape, size and weight of the food.
- The packaging material must protect the food against chemical and physical hazards (oxidation, light, mechanical impact, etc.).
- There should be a label on the packaging material stating the content of the food, the most appropriate usage and storage conditions.
- The packaging material should be designed in a way that enhances the appeal, represents the product in the best way, and should be easy to use.

The packaging rules in the Turkish Food Codex Regulation are as follows:

- All foodstuffs in the Turkish Food Codex must be packaged.
- Packaged foodstuffs must be inaccessible unless the packaging has been changed or opened.
- On the packaging material, the date and number of the permit, the name of the manufacturer, the province where it is located and the initials of the chemical names of the plastic material should be stated.
- Printed and written papers, reprocessed papers and plastics that are not produced as newspapers and food packaging materials are not used as food packaging materials.
- In the production of fruit viols and corrugated cardboard boxes that do not come into direct contact with food, the use of reprocessed paper is allowed, provided that it meets the criteria in the 21st article of this Regulation and is produced in accordance with the product specifications and technique.

2.1.2 Current Situation in Turkey

Packaging is done by vegetable and fruit pack-houses in Turkey, and in this process, the products have different functions such as cleaning, sorting, packaging, storing them in a cold environment when necessary and shipping them to the market. Therefore, pack-houses are places that play a critical role in meeting product demands, controlling and protecting product quality and quantity, and reducing losses. However, in Turkey, direct shipments are made from the field and these packagings are completely out of control and there is no control mechanism related to this. There are no generally accepted fresh fruit and vegetable product and packaging standards in

Turkey, except for export and some private sector organizations. This situation both decreases the value of the product and consumer satisfaction while increases losses.

The "Communiqué on the Procedures and Principles Regarding Standard Practices to be followed in the Wholesale and Retail Trade of Vegetables and Fruits" published in the Official Gazette No. 30199 dated 03.10. 2017 covers the procedures and principles regarding the standards to be followed in the packaging, transportation, storage and retail sale of goods.

In this communiqué, packaging is defined as "transport containers that are made of paper, plastic, wood, metal or a combination of these materials that keeps the goods in it together during the transition from the producer to the consumer, protects it in the best way according to the structure and shape of the goods, facilitates its loading and unloading, transportation and storage" and packaging standards are specified. Although all the standards have been determined, compliance with the rules is very low since the inspections are not carried out.

2.1.3 Current Situation in European Countries

In EU countries, there is no obligation to enter the wholesale market of fresh vegetables and fruits. Fresh vegetables and fruits are generally delivered to the retailer through three channels: wholesale markets, large distributor markets and producer associations. Of these, large distributor markets can make wholesale and retail distribution. In the European Union, vegetable and fruit wholesale markets, retailers, distributors and packers are responsible for the products they sell or mediate to bear the label containing all the necessary information. If the product is unlabeled and the seller accepts the product in this way, he is responsible for labeling the product. Three separate minimum marketing criteria have been set for vegetables and fruit in the EU: extra class, first class and second class. Damage to the products may occur during storage and transportation. In this case, the person holding the goods has the authority to change the product class in line with the changes in the product. Instead of changing the product class, it is also possible to separate the defective product. Each product package must be clearly labeled, legible and visible from the outside. It is obligatory to include information such as the information of the packer, product type, country, quantity and class on the label. Packaged products in EU countries are delivered to the consumer without breaking the cold chain. In product and packaging standards, there are UNECE (United Nations Economic Commission for Europe) standards in the European Union.

2.2 STORAGE

The process of keeping the products in conditions that will preserve their quality so that they can be marketed later is called storage. As many fruits and vegetables cannot be produced in 12 months of the year due to seasonality, they are supplied from warehouses in the off-season. The most frequently stored products in Turkey are lemons, bananas, pomegranates, apples, and garlic however, many other products such as oranges, grapefruit, tangerines, kiwis, grapes, quince, plums, peaches, and carrots are also stored in warehouses to be put on the market after the last harvest season. The most crucial issue regarding the marketing of the products stored in the warehouse is to transport them to the sales locations as quickly as possible after they are removed from the warehouse, while maintaining the cold chain. Cooling the product is similar to putting it to sleep; the awakened fruit spends more energy and decays more quickly.

Since the production of many vegetables is spread over 12 months of the year thanks to greenhouse cultivation, there is no need for storage for these products. These include tomatoes, cucumbers, peppers and greens. Since these products are not cooled in warehouses, they are generally transported in Turkey without the need for a cold chain. Since we already have a very fast logistics and marketing system, there is no significant loss in products.

After the fruits and vegetables are harvested, they need to go through different processes and stages before being put into storage. While some varieties of vegetables and fruits have good quality, they may not be suitable for preservation methods. For this reason, the suitability of the raw material for the purpose should be determined beforehand. When stored under suitable conditions, harvested fruits and vegetables retain their fresh qualities to a great extent. Suitable conditions are provided by adjusting the temperature and humidity. Every fruit and vegetable has a certain temperature and humidity at which it can be best stored. Even the optimum storage requirements of the same fruit and vegetable may differ depending on the variety and the conditions of the region where it is grown. Additionally, no matter how well the conditions are provided in storage, every fruit and vegetable only lasts for a certain period of time.

Consumer expectations are often met with regard to the supply of all kinds of fresh fruits and vegetables throughout the year. In a way, this expectation is realized by long-term storage and transportation of many products over long distances. The term 'storage', now used for fresh produce, almost automatically assumes that fresh fruit and vegetables are kept in controlled conditions. If vegetables are to be stored, it is important to start with a high quality product. The product lot must not contain damaged or diseased items. In addition, containers must be well ventilated and strong enough to withstand stacking. In general, proper storage practices include leaving adequate space between containers for temperature control, relative humidity control, air circulation and ventilation, and not mixing incompatible products. Constructing square rather than rectangular buildings can contribute to temperature management during storage. Rectangular buildings have a larger wall area for each square meter of storage space. Therefore, the amount of heat radiated along the wall is greater, and it is more costly to cool the building. Shading of buildings, painting shops white or silver to reflect the sun's rays, or using sprinkler systems on the roofs of buildings for evaporative cooling also aids in temperature management. The composition of the air in the storage environment can be changed by reducing or increasing the ventilation rate (providing fresh air intake) or by using gas absorbers such as potassium permanganate or activated charcoal. Large-scale controlled or modified atmosphere storage requires complex technology and good management.

2.2.1 Important Objectives and Elements of Storage

The purpose of storage is to slow down the biological activity of the product by minimizing the moisture on the surface of the product and providing a low temperature. Harvested fruits and vegetables continue their life activities. Sugar, organic acid, pectin and tannin continue to break down. They lose their quality slowly or quickly after harvest. In order to prevent these losses, values such as temperature, humidity, oxygen, carbon dioxide and ethylene in the environment where the product is stored are tried to be kept under control. Providing high humidity in the warehouse reduces the water loss of the product.

2.2.2 Requirements for Extending the Life Cycle of Fruits and Vegetables

The most important objective of Turkey in fruit and vegetable production should be increasing the quality. The concept of quality should be evaluated within the concept of long life cycle and total quality, and for this, the homogeneity of the product, its physical properties, taste and aroma, nutritional value, pesticide residues, nitrate accumulation and the way it is placed on the market should be taken into account;

- Attention should be paid not to injure the fruits during harvest.
- Packaged fruits and vegetables should be transported to the warehouse as soon as possible.
- Pre-cooling should be applied during extremely hot periods and in some species before storage.

- Warehouse conditions (temperature, relative humidity, air movement and atmosphere composition) should be adjusted in accordance with the warehouse characteristics and demands of the product (variety) and should be kept constant throughout the storage period.
- Fruits of different maturity levels should not be stored in the same room.
- Different types of fruits and vegetables should not be kept in the same room.
- Fruits intended for long-term preservation and fruits intended for short-term preservation should not be placed in the same room.
- After the period when water, weight losses and decay start to increase, storage should be terminated and fruits and vegetables should be offered for consumption immediately.
- Considering that the rootstocks used and environmental factors before harvest are also effective on the storage abilities of fruits and vegetables, the temperature and relative humidity requirements should be determined for the same variety, according to different regions and different rootstocks.

2.2.3 Factors Affecting Success in Storage

There are many factors that affect the success of the storage of garden products. These factors are;

- The structure of the product,
- The situation of the garden,
- Deficiency and excess of plant nutrients,
- Climate,
- Harvest time (maturity stage, time of day)
- Harvest type,
- Field Operations,
- Transport,
- Packaging applications,
- Warehouse conditions,
- Air movement,
- Temperature,
- Proportional humidity.

To give an example on transportation, which is one of the most important factors affecting quality in storage;

Even warehouses with the most appropriate standards can lose their effectiveness in case of some adverse situations such as delays during transportation, lack of temperature control, incorrect loading, deformations caused by the driver, etc. The goal of anyone involved in transportation should be to ensure that the product is kept in the best possible condition during transport and that the product is moved quickly and efficiently. For this, the product must be properly packaged and properly loaded in a suitable vehicle. Damages (for example, bruises and dents) during harvest and subsequent loading and unloading must be prevented. These increase the rate of deterioration of the product and leave the product vulnerable to attack by putrefactive organisms, even under cold storage conditions. This can be a serious condition in which mechanical damage occurs, causing the fruit to be crushed, injured, rubbed, cut or punctured. Due to bacterial decay, mechanical damage causes great losses. Therefore, it is important to carefully load and unload fruits and vegetables during harvest and post-harvest activities to minimize mechanical damage and prevent losses.

In the transport of fresh fruit and vegetables, each species has quite different needs to be safely protected. The environment during storage and transportation has very important effects on the quality of the product. Damage during transport is most commonly caused by lifting the load and crushing packages in containers. However, the

greatest economic damage is the result of inadequate temperature control. The temperature of the fruits during harvest is in equilibrium with the ambient temperature, which is usually high. These high temperatures make the product susceptible to rapid deterioration and microbiological decay. After harvest, the product should be cooled to safe temperatures as quickly and efficiently as possible. This often requires products to be chilled and kept at this temperature before being loaded into shipping units, whether in refrigerators or coolers.

Rotting of fresh produce during storage mostly occurs as a result of infection by mechanical damage. Infection is mostly triggered by microorganisms such as bacteria and fungi. In addition, many fruits and vegetables are also attacked by putrefactive organisms that enter through natural plant openings or even through the undamaged peel. These infections may have first occurred during plant growth in the field. However, they are usually not noticed until after harvest and are often only visible during storage and ripening.

2.2.4 Benefits of Storage

- Storage provides the opportunity to bring products produced in the seasonal cycle to the market in the longest possible time. The consumer has the opportunity to find the product he is looking for in the market for a longer time and to consume quality products at a normal price.
- Thanks to the preservation, even if the production remains the same, that product can be found in the market for a longer period of time and with higher quality.
- The amount of product consumed increases during the extended marketing period.
- Storage provides better quality in some fruits.
- It provides maturation, preservation of good product, and standardization.
- The grower has the opportunity to sell his product at a good price.
- Losses in terms of quality and quantity as a result of storing the products are prevented.
- The workforce of the production and marketing company is evenly distributed throughout the year.
- In some periods, the delivery of the surplus product to the market and loss of it is prevented.
- The amount of rotten products (25-30% of the fruits and vegetables produced in Turkey are thrown away on average) is reduced, thereby it contributes to the country's economy.
- It is ensured that products are delivered to every part of the country.
- Export is developed.
- It is ensured that the freshness of the products processed into canned food is preserved, the processing season is extended and the products are of higher quality.

2.2.5 Things to Consider in the Warehouse

- The use of corridors instead of warehouse doors that open directly to the outside is essential for good preservation.
- Isothermal doors should be used instead of ordinary wooden warehouse doors.
- Laying the tangerine crates on pallets instead of directly on the floor is essential for good ventilation.
- In the warehouse, crates should be placed in such a way that there are enough gaps in between for good ventilation.
- Instead of irregular and random ventilation, forced ventilation should be done with aspirators connected to time clocks or with aspirators connected to differential thermostat.
- Ventilation chimneys should be opened in warehouses and corridors.

- Most of the losses that occur during storage are spoilage caused by fungi. To prevent this, it is necessary to wrap it in fungicide papers.
- Early harvested citrus species should be bleached immediately after harvest. For this, ethylene gas is applied for 36 hours at 28-29 °C and 90-96% relative humidity.
- Waxing with a suitable benzimidazolefungicide or other fungicide components can be applied to prevent water loss in the product.

2.2.6 Storage Conditions and Storage Periods

Table 3 Storage Conditions and Retention Period of Some Fruits ⁹

Type	Temperature (C)	Proportional Humidity (%)	Retention Period
Apple	(-1)-4	85-90	2-8 months
Quince	0-2	90	3-4 months
Kiwi	(-5)-0.5	90-95	4-5 months
Peach	(-1)-1	85-90	2-4 weeks
Nectarine	0-1	85-90	3-6 weeks
Apricot	(-1)-0	90	2-3 weeks
Plum	(-1)-0	90-95	2-4 weeks
Cherry	(-1)-2	90-95	2-3 weeks
Sour Cherry	(-1)-0	90-95	1 week
Fig	(-1)-0	90-95	1-2 weeks
Pomegranate	0-2	90-95	2-4 months
Mulberry	0	85-90	5-7 days
Raspberry	0	85-90	5-7 days
Strawberry	0-2	90-95	5-7 days
Black Currant	0	85-90	2-3 weeks
Persimmon	(-1)-1	85-90	2-4 months
Pear	(-1)-0	90-95	3-7 months
Banana (Yellow)	13-16	85-90	5-10 days
Banana (Green)	12-14	85-90	2-4 weeks
Chestnut	0	65-75	1 year
Hazelnut	0-4	70	1 year
Orange	4-6	85-90	5 months
Mandarin	4	85-90	6 weeks
Satsuma	3	85-90	3-4 months
Grapefruit	8	85-90	6 months
Lemon (Green)	10-13	85-90	3-9 months
Lemon (Yellow)	5	85-90	1 month
Grape	(-1)-0	90-95	2-6 months
Blackberry	0	85-90	5-7 days
Avocado	5-7	85-90	3-4 weeks
Gooseberry	0	85-90	2-3 weeks
Blueberry	(-0.5)-0	90-95	2-4 weeks

⁹ Communiqué on the Standards to be Followed in the Wholesale and Retail Trade of Vegetables and Fruits, Official Gazette 29 June 2021 No:31526

Table 4 Storage Conditions and Retention Period of Some Vegetables¹⁰

Type	Temperature (C)	Proportional Humidity (%)	Retention Period
Artichoke	(-0.5)-0	90-95	2-20 months
Asparagus	0-2	95-100	2-3 weeks
Beans	3-5	95	1-2 weeks
Beet	0	98-100	4-6 months
Broccoli	0	95-100	10-14 days
Brussels Sprout	0	95-100	3-5 weeks
Cabbage	0	98-100	3-24 weeks
Napa Cabbage	0	95-100	2-3 months
Carrot	0	90-95	5-6 months
Cauliflower	0	95-98	3-4 weeks
Celery	0	98-100	2-3 months
Sweet Corn	0	95-98	5-8 days
Cucumber	10-13	95	10-14 days
Eggplant	8-12	90-95	1 week
Garlic	0	65-70	6-7 months
Leek	0	95-100	2-3 months
Lettuce	0	98-100	2-3 weeks
Tomato (ripe)	8-10	90-95	4-7 days
Melon	0-5	90-95	2-3 weeks
Watermelon	10-15	90	2-3 weeks
Mushroom	0	95	3-4 days
Okra	7-10	90-95	7-10 days
Scallion	0	95-100	3-4 weeks
Onion	0	65-70	1-8 months
Parsley	0	95-100	2-2.5 months
Pea	0-5	95-98	1-2 weeks
Pepper	7-13	90-95	2-3 weeks
Potato	4	90-95	5-10 months
Zucchini	10-13	50-70	3-5 months
Spinach	0	95-100	10-14 months
Vegetable Marrow	5-10	95	1-2 weeks
Pumpkin	10	50-70	6 months
Sweet potato	13-16	85-90	4-7 months
Turnip	0	95	4-5 months
Horseradish	(-1)-0	98-100	10-12 months
Tomato (green)	13-21	90-95	1-3 weeks

2.2.7 Considerations in the Storage of Packaged Fruits and Vegetables

- Fresh fruit and vegetable products should be kept without breaking the cold chain, depending on their types.

¹⁰ " Communiqué on the Standards to be Followed in the Wholesale and Retail Trade of Vegetables and Fruits, Official Gazette 29 June 2021 No:31526

- The products to be stored should be transferred to the appropriate warehouses without waiting in a time that will not affect the product quality in order to minimize microbial development.
- The temperature and humidity of cold stores should be controlled, preserved in the same location and recorded.
- The inside of the cooling systems should be kept in clean and healthy conditions.
- Products should be classified according to product groups and placed in warehouses.
- The condensed steam and defrost water from the cooling system should not drip onto fresh fruit and vegetables. In cold storages, the product should not be stored under cooling systems to prevent water condensation or water flowing over the product.
- When stacking in the warehouses, the capacity of the warehouse should be taken into account, the product should be stacked in a way that does not prevent the cold air circulation and does not prevent the implementation of cleaning plans. In order to ensure a regular and healthy air flow in the warehouse, certain gaps must be left between the pallets and the walls. The distance of the products in the warehouse from the walls and the height from the ground should be such as to provide sufficient air flow.
- Deteriorated or toxic products in business warehouse should be stored in a separate area that will not allow mixing and labeled with defined labels or destroyed immediately.
- Stock management and placement in the warehouse should generally be done according to the first-in, first-out rule.
- Preparation areas should only be used for product preparation and product storage should never be done¹¹.

2.2.8 Situation in Turkey

Since the cold storages established in Turkey are very young, they have been established with the most modern systems, however, their capacity adequacy is very weak. In many packaging facilities that focus on exports, cold storage is inherent in the business. However, in cases where domestic market products are a forced transition point, the adequacy of cold storage is very, very low. The Ministry of Agriculture and Forestry also carries out grant projects for the development of Rural Development supported by the European Union in order to increase the packaging and storage capacity and quality in Turkey.

Large suppliers, who are conscious and experienced about the products that need to be taken into the cold chain and stored, use warehousing extensively. In this way, we consume many products from warehouses instead of importing them out of season. Examples of these are crops such as citrus fruits, apples, pomegranates, quince, onions, garlic.

As in most developing and even developed agricultural economies, the majority of agricultural production enterprises in Turkey are small producers and family businesses that produce on fragmented lands. Among the important problems of small manufacturers, the costs arising from not being able to reach large scales at various stages of the supply chain and inefficiencies arising from not being able to access technology and markets can be listed. This situation also has important reflections on logistics processes. Important processes related to the supply of raw materials, the supply and use of agricultural machinery and equipment used in the production and harvesting process, and post-harvest storage are adversely affected. Small businesses also lose their cost advantage since they purchase raw materials in relatively low quantities and their direct access to suppliers is limited, and they need an intermediary institution for procurement. Due to small scales, there are problems such as outsourcing the warehouse service or not being able to access sufficient warehouse service.

¹¹ Hygiene Principles of Production and Post-Harvest Stages of Fresh Fruit and Vegetables Practice Guide, Ministry of Agriculture and Forestry Guide No: 11

2.2.9 Situation in European Countries

Southern EU countries are producers of fresh fruits and vegetables, but since these products are not sufficient for the whole EU, the EU is a major importer of fresh fruits and vegetables. With the high level of welfare, products come to European countries from almost the most distant points of the world. Due to long-term transportation, these products always come with a cold chain and are again necessarily put in cold storage. Therefore, almost all fresh fruit and vegetable suppliers in EU countries have cold storage. Contrary to Turkey, all companies that participate or do not participate in cases also operate cold storage.

Countries that are importers of most of the products do not store for stocking purposes since they cost the products at high prices. Instead, they supply each product fresh in season from different countries of the world. However, southern countries, which are producers, use storage to supply many products regularly, as in our country.

Although fresh fruits and vegetables imported in the European Union are not checked by food inspectors in terms of the HACCP (Hazard Analysis and Critical Control Point) system, it is considered a strong document to have this document. Large retail groups in the European Union have gathered the minimum standards required for agricultural products grown in their own countries or imported from abroad, under the name of GLOBALGAP, in order to ensure the consumption of healthy and high quality products. The certificate in question is accepted and required by large chain stores in the EU today. In addition, GLOBALGAP encourages the implementation of the HACCP system and supports its principles.

Since the cold chain transportation of fresh fruits and vegetables is not mandatory in EU legislation, suppliers in southern EU countries decide whether they will pre-chill according to the conditions of the country to which they will send the products and seasonal temperatures. There is no obligation to register with the wholesale market in the wholesale of vegetables and fruits in the EU, and such an arrangement is considered contrary to both the EU's competition rules and the competition legislation in the member states. Businesses operating in wholesale markets in the EU distribute their goods to small tradesmen businesses that do not have the opportunity to directly obtain the product they need. In wholesale markets in the EU, not only fresh vegetables and fruits are sold, but also separate venues are allocated for wholesale of meat products, dry food, bakery products, basic necessities, even fresh flowers, etc. For this reason, wholesale markets in EU countries are called Wholesale Food Markets. Wholesale markets in the EU have warehouses and cold storages to ensure that the products are stored in the healthiest way possible. In wholesale markets in the EU, services such as cleaning and security are provided by private companies. The wholesale markets are located and organized in a way that allows all kinds of vehicles to enter and exit easily.

There are many directives that contain very detailed standards and hygiene conditions for all necessities and especially foodstuffs. These conditions apply to both imported and EU domestic products. All quality, standard, hygiene and calibration controls of products imported from countries outside the EU are carried out at customs. Thus, non-standard products are prevented from entering the domestic market. Compliance control is carried out for all goods coming from countries outside the EU. If most of the products imported from third countries do not comply with the standards, the coordinating authorities of the relevant countries are informed.

2.3 TRANSPORT

Transport allows fresh produce to move quickly through the supply chain. Fresh products must be carefully protected during transport to reduce staining and contamination by mechanical damage, temperature changes, and foodborne pathogens. The transport vehicle must be well-maintained and in hygienic conditions. Transport is often the most expensive element in the marketing channel. The shipping method of fresh fruits and vegetables is determined by the distance, deterioration time and value of the product. Delays can lead to poor quality and loss of product. The goal of anyone involved in shipping should be to ensure that the product is kept in the best possible

condition during transit and that the product is moved quickly and efficiently. For this, the product must be properly packaged and properly loaded in a suitable vehicle.

2.3.1 Important Factors in Transportation

Transportation between the starting point of the fresh product and the target point of use takes place in many stages. Transport provides a series of links in the chain of movement of fresh fruits and vegetables from the farm to the consumer. The product is susceptible to both physical or chemical damage and microbiological contamination during transport. Therefore, it is critical that a comprehensive food safety and quality program give adequate attention to the management of the shipping environment.

There are many modes of transport and types of equipment for transporting products, important factors in their selection include:

- Departure and arrival points
- The value of the product
- The degree of perishability of the product (time in transit)
- Amount of product to be transported
- Recommended storage temperature and relative humidity
- Outside temperature conditions at departure and arrival points

The lifespan of fresh fruits and vegetables is one of the most important factors in deciding the mode of transport since all other factors will be unimportant if the product spoils.

The choice of transport mode for fresh fruit and vegetables is determined by time-determined factors such as the distance of transportation, perishability and value of the product.

The principles of transport are:

- Loading and unloading should be done as carefully as possible.
- The transportation time should be as short as possible.
- Taking into account its sensitivity to physical damage, the product must be well protected.
- It must not be allowed to overheat - the correct temperature level must be maintained during transport.
- Ventilation, fan and air supply must be available.
- Appropriate relative humidity rates should be ensured - water loss of the product should be kept to a minimum.
- As appropriate, the transport vehicle should not be left in the sun and the product should be protected from sunlight with a cover.
- The product should be protected from sun and rain in loading and unloading areas.

2.3.2 Mode of Transport and Type of Equipment

Fresh fruits and vegetables can be shipped with appropriate packaging by all transportation modes in the world. These modes of transport, as in other products, are provided by land, air, sea, railway and intermodal solutions consisting of a few of them.

- Highway: Transportation of all kinds of commercial vehicles or sea containers between the port and shipping address
- Airline: Cold chain or dry cargo lines
- Seaway: Refrigerated Containers (for long hauls), bulk hauliers, tracked ropax ships
- Railroad: Sea Containers, Insulated Wagons

The most used modes of transport in Turkey are trucks, lorries and panel vans on the road, containers and palletized ropax ships on seaways, and air cargo for perishable products in airlines.

Equipment to be used in international road transport is clearly stated in ATP, however, since fresh fruits and vegetables are not covered by ATP, most of them are transported by frigorific vehicles, but these vehicles do not have ATP certificate. Although it cannot be immediately concluded that the transportation made by undocumented vehicles will be of worse quality, since these vehicles are relatively old, a decrease in quality in transportation is inevitable.

2.3.3 Transport to Post Harvest Packing Facility

In the guidelines prepared by the Ministry of Agriculture and Forestry, the matters stated in the " Communiqué on the Procedures and Principles Regarding Standard Practices to be followed in the Wholesale and Retail Trade of Vegetables and Fruits" should be taken into account in the packaging, transportation, storage and retail sale of products starting from the primary production area. In accordance with this, primarily;

- Fresh fruits and vegetables should be transported in appropriate transport vehicles.
- In the protection of the cold chain, attention should be paid to ensure that the products are transported in the cold chain depending on the type and variety.
- The temperature in the vehicles should be adjusted in accordance with each product. In frigorific vehicles, the temperature must be traceable.
- Different product groups that may harm each other should not be transported together at the same time.
- If mixed transport is to be carried out in different product groups, the product groups closest to each other in transport temperature should be selected.
- In addition, effects such as odor, ethylene, etc. should be considered in the selection of these product groups.
- Fresh fruits and vegetables should be transported and stored under conditions that minimize potential microbial, chemical or physical contamination.
Necessary measures should be taken to protect fresh fruits and vegetables from harmful organisms while transporting harvested products.

2.3.4 Pre-Cooling

The most important issue for the preservation of the cold chain is the constant temperature. Refrigeration equipment in trailers, trucks and containers is designed to retain cold load, not to cool hot loaded product. For products loaded at a certain temperature, the vehicle must be brought to the same temperature as the product before loading.

Pre-cooling extends product life by reducing:

- The internal temperature of the equipment,
- The rate of respiration and heat produced by the product,
- Ripening speed,
- Loss in moisture (wrinkling and wilting),
- Ethylene production (maturation gas produced by the product),
- Spread of rot

The effect and success of pre-cooling depends on:

- Time between harvest and pre-chill; pre-chill should be done as soon as possible after harvest.
- The type of shipping container if the product is prepackaged;
- First product temperature, final product temperature and the difference between them being small

- Cooling period
- Sanitation of air or water used for pre-cooling to reduce rotting organisms.
- Maintaining the recommended temperature after pre-cooling.

2.3.5 Situation in Turkey

When the logistics sector in Turkey is evaluated in terms of services, it is divided into 2 main groups as international and national transporters. Whether it is a necessity or not in international transportation, fresh fruits and vegetables are transported in the cold chain in order to preserve the quality, which causes the intensive use of frigorific vehicles. Turkey owes its strong position in exports to this powerful frigorific truck fleet. Considering those used in international transportation, most of the national and international brands used are manufacturers with ATP certificate. Some of these vehicles have valid ATP certificates, the other majority have never received ATP certificates since they do not need them even though they are able to obtain one, however, eventually they will be able to obtain an ATP certificate very quickly.

When we consider the transportations in the domestic market, we see that imported and expensive fruits are "sometimes" transported by cold chain. The vast majority of fresh fruit and vegetables in Turkey are transported by non- frigorific flatbed or tarpaulin vehicles. Existing frigorific vehicles are sufficient only for the loads they carry. In this regard, the current capacity for the transportation of fresh fruits and vegetables by frigorific vehicles is very insufficient or even negligible. It is currently impossible for all vehicles to maintain a cold chain without being equipped with refrigerated boxes.

There are risks in terms of both food safety and losses at every stage of the agri-food supply chain. One of the most important approaches that directly affect human health in the food supply chain is "Cold Chain Logistics". Food whose cold chain is broken at any stage of the supply chain cannot be considered as safe food. Another function of the warehouses in the packaging facilities is to pre-cool, however, due to the insufficient number of warehouses, pre-cooling cannot be done either. Considering that many wholesale markets do not have warehouses, it is seen that pre-cooling, which is the starting point of the cold chain, cannot be done. Since the transport vehicles are designed to keep the products cold, not to cool them, loading without pre-cooling is incorrect.

With the increasing foreign trade figures every year and the increasing investments of the businesses operating in the sector in parallel, the Transport and Storage Sector is the sector that has the highest share in turnover within the service sector (TURKSTAT, 2020). The cold chain investments of businesses are also expanding, especially owing to the increase in food exports. Implementations of cold chain logistics in Turkey are seen in pharmaceutical and vaccine logistics, especially in the food sector. The fact that agriculture has a large place in the country's economy and the dense population are the main factors that cause food transport.

The "Communiqué on the Procedures and Principles Regarding Standard Practices to be followed in the Wholesale and Retail Trade of Vegetables and Fruits" published in the Official Gazette No. 30199 dated 03.10. 2017 for the cold chain transportation and storage of agricultural products. The purpose of the Communiqué is to reduce food losses to the lowest level by implementing international standards at all stages, starting from the production stage until the products reach the chain markets. The Communiqué includes the standards of packaging to be used for fruits and vegetables, the characteristics of transportation and storage processes and the rules to be followed during the display at retail outlets. However, the warehouse and transportation infrastructure in Turkey is not ready for this, the logistics industry requires incentives for compliance with the communiqué.

2.3.6 Situation in European Countries

Especially Spain, Italy and France are countries that have established and operate inspection, control and sanction mechanisms for the effective implementation of ATP. All three countries are countries that also apply ATP in their domestic transportation. All three are generally active participants in UNECE's ATP surveys. The legal system of the EU best practice countries also shows some similarities with Turkey. The European Commission is making significant improvements in logistics processes through a number of projects funded under the Horizon 2020 program, chain integration and digital technologies. Within the scope of the Internet of Food and Farm (IoF) project, digital equipment such as RFID (Radio-frequency identification), multi-dimensional barcodes, 3D labels and smart packaging, which ensures traceability, monitor the processes in storage, transportation and shelves. EU countries are very successful in the implementation of ATP requirements in the international arena and in the domestic market, and the implementations are subject to controls and sanctions. They mostly use frigorific vehicles to keep the quality high and comply with the hygiene rules. When EU legislation is examined, it is mandatory to comply with hygiene rules. The use of cold chain is not required for the transportation of fresh fruits and vegetables within Europe, however, European suppliers and buyers do prefer the cold chain. Although the shipments from the Netherlands, which is Europe's largest import point, to other countries are mostly by non- frigorific trucks, tarpaulin vehicles are also used according to seasonal conditions. Spain adapted the ATP to its own laws, but still did not add fresh fruit and vegetables. Cold chain vehicles are also used in France and Italy, however, there is no legal obligation in this regard.

In short, in the majority of EU countries, there is no obligation to transport fresh fruits and vegetables in the cold chain, however, suppliers generally prefer the cold chain.

2.4 TRANSPORT AND STORAGE QUALITY

Since the values that can be adjusted or kept under control, such as temperature, humidity, oxygen, carbon dioxide, used in storage are the same as those in transportation, all the details on this subject will be discussed in this section of the report.

2.4.1 Temperature and Humidity

It has been determined that proper temperature and humidity management from harvest to consumer is the most efficient method to maintain quality. An increase in temperature leads to an increase in the natural respiration rate of all products, depletion of nutrient stocks and water content. Respiration is a complex series of chemical reactions that convert starch into sugar and sugar into energy. Cooling the product will slow down the respiratory rate and extend the shelf life of the product.

When a fruit or vegetable is plucked from a tree or plant, water is lost through evaporation. For this reason, storage and transportation conditions should be designed so as not to cause excessive water loss. Damage to the product by high temperature and low humidity in the warehouse can greatly increase water loss beyond the amount that inevitably results from natural causes. Maximum storage life can only be achieved by storing undamaged products at the lowest temperature the product can withstand and at the most appropriate relative humidity for the product. At very high relative humidity, the harvested fruits preserve their nutritional value, appearance, weight and taste, while when the relative humidity is reduced, wilting, softening and watering occur in the fruits. Below the optimal range, evaporation by transpiration leads to the formation of wrinkled fruits.

2.4.2 Air Composition

The product is affected by the composition of the air in which it is in. Gases that affect metabolism during storage are oxygen and carbon dioxide. Low O₂ reduces spoilage and disease losses. If the O₂ concentration of the environment falls below a certain value, which varies according to the species and variety, the respiratory pattern is disturbed and anaerobic respiration gradually increases. If the O₂ concentration of the environment rises above the value in the air, the metabolism accelerates and ripening happens earlier and if the CO₂ concentration of the environment is increased by 0-3%, maturation slows down. In some types and cultivars, high CO₂ concentration impairs volatile substance synthesis. Aroma composition changes, taste and flavor deteriorate. The movement of the air in the environment removes the heat, humidity, CO₂ and volatile substances produced by the product and increases the diffusion rates of these by keeping the temperature and concentration differences between the inside and outside of the product high. In case of insufficient and irregular air movement, special micro-ecologies are formed in the areas where the air movement does not reach enough in the warehouse. In these places, the temperature is high and the relative humidity is low. Under these conditions, the product ripens or ages rapidly. In case of excessive air movement, water loss from the product increases. Significant weight loss and creases occur especially in products close to fans and in the open. In order for the cold air to circulate between the stacks in the warehouse, a speed of 0.5-1 m/sec, the fans in the warehouse should be strong enough to rotate the warehouse air 15-25 times per hour.

2.4.3 Considerations During Transport and Storage

Transport allows fresh produce to move quickly through the supply chain. Fresh produce must be carefully protected during transport to reduce staining and contamination by mechanical damage, temperature changes, foodborne pathogens. The transportation method of fresh fruits and vegetables is determined by the distance, deterioration time and value of the product. Delays can lead to poor quality and loss of product. The goal of anyone involved in transportation should be to ensure that the product is kept in the best possible condition during transit and that the product is moved quickly and efficiently. For this, the product must be properly packaged and properly loaded in a suitable vehicle.

The transport between the starting point of the fresh product and the target point of use takes place in many stages. Transport provides a series of links in the chain of movement of fresh fruits and vegetables from the farm to the consumer. The product is susceptible to both physical or chemical damage and microbiological contamination during transport. It is therefore vital that a comprehensive food safety and quality program give adequate attention to the management of the transport environment.

The environment during storage and transportation has very important effects on the quality of the product. Damage during transport is most commonly caused by lifting the load and crushing packages in containers. Lack of adequate temperature control is one of the key factors directly affecting the quality of the product. The temperature of the fruits during harvest is in equilibrium with the ambient temperature, which is usually high. These high temperatures make the product susceptible to rapid deterioration and microbiological decay. After harvest, the product should be cooled to safe temperatures as quickly and efficiently as possible. This often requires products to be cooled and kept at this temperature before being loaded into transport units, whether in refrigerators or coolers.

In the Communiqué on the Standards to be Followed in the Wholesale and Retail Trade of Vegetables and Fruits, which was published in the Official Gazette dated 29.06.2021 and will enter into force on 01.07.2022, the products subject to the cold chain are clearly specified. The products specified in the Communiqué are products that are transported in the cold chain in many countries around the world and in Turkey, even if there is no legal obligation. It is envisaged that these products will be kept in the cold area not only in transportation but also in sales places. Products subject to the cold chain are:

Raspberry, blackberry, strawberry, mulberry, plum, blackcurrant, fig, pumpkin blossom, apricot, cranberry, cherry, asparagus, mango, mangosteen, mushroom, blueberry, nectarine, passion fruit, pitahaya (dragon fruit), soybean sprouts, peach, persimmon, grape, cherry, loquat, apricot.

2.4.4 Main Causes of Losses During Transport and Storage

The most serious decrease in the value and quality of fresh produce occurs immediately after harvest. For this reason, the first transport to the first unloading area after harvest is considered to be the most important transport in terms of preventing losses. Today, the effort made in the process from the farmer to the consumer for the harvested products is enormous. Due to adverse conditions or changes that may occur during transportation, problems may occur that may lead to nutrient loss. These main reasons can be listed as follows:

1. Failure to Provide Cold Chain Management During Transport

Cold chain is the name given to the logistics system that includes thermal or chilled packaging methods from the production center to the point of consumption, providing the most ideal conditions for perishable products in order to increase the shelf life of the products and protect their quality.

Refrigeration provides the following benefits for fresh fruit and vegetables:

It reduces respiration, reduces spoilage and natural maturation rates and also reduces transpiration of fruits and vegetables, reduces water loss and reduces wrinkling. While it reduces ethylene production and slows down ripening, it increases resistance to the effect of ethylene. It reduces the activities of microorganisms and reduces blackening, loss of texture, taste and nutritional value.

It has been determined that proper temperature management in the time period between harvest and consumption is the most efficient method to maintain quality. An increase in temperature leads to an increase in the natural respiration rate of all products, depletion of nutrient stocks and water content.¹²

2. Failure to Provide Ideal Temperature and Relative Humidity

Although future conditions are unknown, at all stages of the cold chain process, the product should be kept at the lowest recommended storage temperature. Even if the crop gets hot during manual handling, the golden rule when loading and unloading perishable horticultural crops is to keep the crop as cold as possible for as long as possible. A 90-95% RH (Relative Humidity) environment is needed to ensure the longest shelf life of most fruits and vegetables. During the formation process, the tree/plant assumed the function of the source of water. For this reason, storage and transportation conditions should be designed so as not to cause excessive water loss. Damage to the product by high temperature and low humidity in the warehouse can greatly increase water loss beyond the amount that inevitably arises from natural causes. Maximum storage life can only be achieved by storing undamaged products at the lowest temperature the product can withstand and at the most appropriate relative humidity for the product. At very high relative humidity, the harvested fruits retain their nutritional value, appearance, weight and taste, while when the relative humidity is lowered, wilting, softening and watering occur in the fruits. Below the optimal range, evaporation by transpiration leads to wrinkled fruit¹³.

3. Air Composition

Gases that affect metabolism during transportation and storage are oxygen and carbon dioxide. Low O₂ reduces spoilage and disease losses. If the O₂ concentration of the environment falls below a certain value, which varies according to the species and variety, the respiratory pattern is disturbed and anaerobic respiration gradually increases. If the O₂ concentration of the environment rises above the value in the air, metabolism accelerates, if the CO₂ concentration is increased by 0.03%, maturation slows down. In some species and cultivars, high CO₂

¹² Karaçalı İsmail, 2006. Bahçe Ürünlerinin Muhafazası ve Pazarlanması, Ege Üniversitesi Basımevi, Bornova, İzmir.

¹³ J. Aked, Cranfield University at Silsoe. 2002. Fruit and vegetable processing Improving quality Maintaining the post-harvest quality of fruits and vegetables. S:119-135. Published by Woodhead Publishing Limited, Abington Hall, Abington Cambridge CB1 6AH, England

concentration impairs volatile substance synthesis. The movement of the air in the environment removes the heat, humidity, CO₂ and volatile substances produced by the product and increases the diffusion rates of these by keeping the temperature and concentration differences between the inside and outside of the product high¹⁴.

4. Packaging and Improper Packaging

The product leaving the packaging plant must be in a suitable packaging during transport to the market. Due to its proximity to the market, locally produced fruit can be quite ripe and ready to eat. During a long post-harvest distribution period, the crop should be free of mechanical damage and should be kept away from conditions that would lead to a noticeable drop in quality. Fruits and vegetables, particularly soft-skinned and succulent crops such as tomatoes, leafy greens and peaches, are more susceptible to cross-contamination by plant and human pathogens. Damaged, diseased and overripe fruits should not be transported. These must be removed from the shipping containers before loading other products. The tight or loose arrangement of the product in the package causes significant mechanical damage. The use of solid-surface containers, such as plastic crates, wooden crates, and fiber boxes, can reduce serious damage to fruit and vegetables during packaging and transportation¹⁵.

5. Mixed Transport of Products

If logistically feasible, products should be loaded as mixed loads only when their temperature and humidity requirements, ethylene sensitivities and odor absorption capacities are compatible with each other. Ethylene producing products and ethylene sensitive products should not be transported together. Products whose storage and transportation temperatures are close to each other should be transported together. Products that have strong odors such as onions and garlic should not be transported together with other products.

¹⁴ Türk, R., Yıldırım, I., İkat, D.,2015. Meyve ve Sebzelerin Muhafazasında Soğuk Depoların Kalite ve Kantiteye Etkileri. Tesisat Mühendisliği - Sayı 148

¹⁵ Türk Rahmi., Erkan, M., Güneş, N.T., Koyuncu, M.A.,2017. Bahçe Ürünlerinin muhafazası ve Pazara Hazırlanması. Somtad Yayınları Ders Kitabı No:1 Antalya.

3. RELATED ARTICLES AND ASSESSMENTS IN TURKISH LEGISLATION ON PACKAGING, STORAGE AND TRANSPORT OF FRUIT AND VEGETABLES

The main legislation and regulations regarding the trade of vegetables and fruits and other goods with sufficient supply and demand depth in Turkey are as follows;

- EU "Hygiene Package" (Ministry of Agriculture and Forestry)
- Communiqué on the Procedures and Principles Regarding Standard Practices to be Followed in the Wholesale and Retail Trade of Vegetables and Fruits (Ministry of Trade)
- Law No. 5957 on the Regulation of Trade of Vegetables, Fruits, and Other Goods with Sufficient Supply and Demand Depth. (Ministry of Trade)
- Ministry of Trade, Regulation on Wholesale Fruit and Vegetable Markets
- Istanbul Metropolitan Municipality, Regulation on Wholesale Fruit and Vegetable Markets
- Regulation on Market Places (Ministry of Trade)

3.1 EU HYGIENE PACKAGE

The Republic of Turkey has completed its alignment with the EU acquis on food-related issues. All of the above-mentioned EU Hygiene package is also strictly included in Turkish laws, however, there are deficiencies in implementation due to the lack of supervision on some issues.

Regulation (EC) No 852/2004 in 2011: on the Hygiene of Foodstuffs; Regulation (EC) No 853/2004: Specific Hygiene Rules for Food of Animal Origin; Regulation (EC) No. 854/2004: Specific Rules for the Organization of Official Controls on Products of Animal Origin Intended for Human Consumption; Regulation (EC) No 882/2004: on Official Controls Performed to Ensure the Verification of Compliance with Feed and Food Law, Animal Health and Animal Welfare Rules, and lastly, Commission Regulation (EC) No 37/2005: on the monitoring of temperatures in the means of transport, warehousing and storage of quick-frozen foodstuffs intended for human consumption were published in the Official Gazette.

The importance of food safety is constantly increasing, in this context, both the legislation and the market attach importance to ISO 22000 Food Safety Management System, HACCP and Farm to Fork documents. Every link of food production should be viewed as a critical link and should be audited. As can be seen from the figure below, the transport, which is the subject of this report, is only one of these rings, and perhaps the simplest.

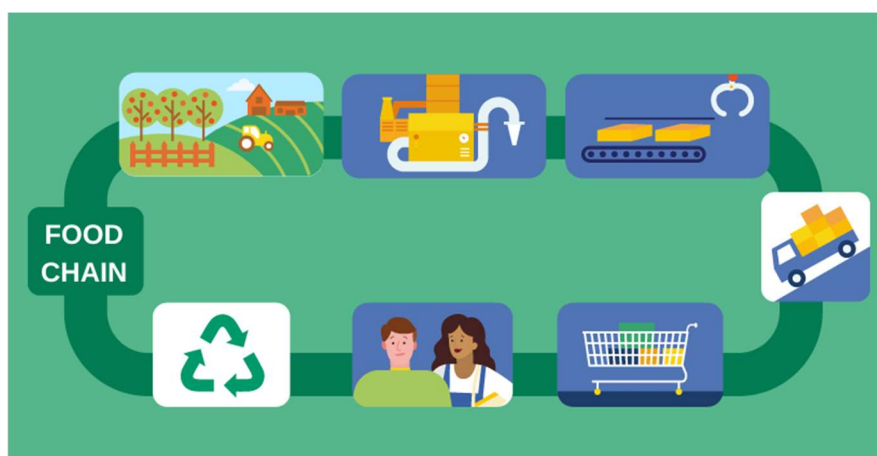


Figure 4 Food Chain

Due to increased drought and production costs, food saving has become even more important. As in many countries in the world, campaigns have been launched to reduce food waste in Turkey. The Ministry of Agriculture and Forestry has prepared slogans in this regard, as can be seen in the figures below, and tries to reach the public through all kinds of press organs and social media.



Figure 5 Protect Your Food Protect Your Table



Figure 6 Secure Food



Lojistik Sektöründe Gıda Kaybını
Önlemeye ve Azaltmaya Yönelik

KILAVUZ

GIDANI KORU
SOFRANA SAHİP ÇIK

Figure 7 A Guideline to Reducing Food Loss in the Logistics Industry

The Ministry of Agriculture and Forestry strictly controls production in its jurisdictions, but since inspection teams are not established for logistics, the inspection in this link of the chain is carried out by the Ministry of Transport and Infrastructure and Ministry of Trade officials.

3.2 COMMUNIQUE ON THE STANDARDS TO BE FOLLOWED IN WHOLESALE AND RETAIL TRADE OF VEGETABLES AND FRUIT

The laws and controls of the Ministry of Agriculture and Forestry mostly cover food production, however, since the Ministry of Trade is also responsible for the trade of these products, it can work in a wider area.

The Ministry of Trade determined the standards to be followed in wholesale and retail trade of vegetables and fruits with the Communiqué on the Standards to be Followed in the Wholesale and Retail Trade of Vegetables and Fruits, which was published in the Official Gazette dated 29.06.2021. With this Communiqué, the procedures and principles regarding the standards to be complied with in wholesale and retail trade of goods were determined in accordance with the Law No. 5957 on the Regulation of Trade of Vegetables, Fruits, and Other Goods with Sufficient Supply and Demand Depth.

The Communiqué covers the procedures and principles regarding all standards that must be followed in the packaging, transportation, storage and retail sale of goods. With this communiqué, a total of 26 products, mainly strawberries, plums, grapes, figs, apricots, cherries, mangoes, nectarines, peaches, sour cherries, loquat, were included in the cold chain. All necessary rules have been determined to ensure that the goods included in the cold chain are cooled after packaging and that this chain is not broken until the point of sale. Along with many hygiene elements related to packaging standards, they also stipulated their compliance with the cold chain when necessary.

Transport standards specified in the Communiqué:

- The goods included in Annex-1 of the Communiqué will be transported in the cold chain by frigorific vehicles suitable for pallet use after cooling. Covered or tarpaulin transportation vehicles will be used to transport these goods to the wholesale market at the production site or to the sorting, packaging or pre-cooling facility.
- Measures will be taken to prevent goods from damaging each other during the transportation of different goods in the same vehicles.
- The provisions in question shall not be applied in the transport of goods purchased from manufacturers or wholesale markets for retail sale by retailers registered in the Union of Chamber of Merchants and Craftsmen, and goods sold directly to consumers by retailers on a retail basis.
- The authorities of the Ministry of Agriculture and Forestry will be reserved in the official controls regarding the packaging, storage, transportation and retail sale of the goods, regarding the compliance with the Law No. 5996 on Veterinary Services Plant Health Food and Feed and the regulations prepared based on the mentioned Law.

A one year period is foreseen for the implementation of all these standards and it is planned to enter into force on 1 July 2022.

The Directive on Type Testing and Technical Inspections of Special Equipment Used in the Transportation of Perishable Foodstuffs has been published. The principles of inspection and tests to be carried out for the vehicles to be used in the products in question were determined. As is known, in accordance with the regulation prepared by the Ministry of Transport and Infrastructure, as of January 1, 2022, the equipment used in perishable foodstuffs transportation must be produced in accordance with ATP. For vehicles manufactured before 2022, it is obligatory to obtain a BTB Certificate until 2025.

This Communiqué covers the procedures and principles regarding the standards to be followed in the packaging, transportation, storage and retail sale of goods.

3.2.1 Packaging Standards

The packaging standards in the Communiqué are as follows.

- (1) Disposable or reusable packaging is used for packaging of goods.
- (2) The goods are packaged in such a way that they are protected and transported under appropriate conditions. The packages are purified from all foreign matter.
- (3) Disposable packages come in suitable sizes that can be fully placed on pallets of 80x120, 100x120 or 60x80 cm.
- (4) Reusable packages come in 60x40 cm, 40x30 cm, 40x40 cm and 30x20 cm base sizes so that they can be fully placed on 80x120 or 60x80 cm pallets.
- (5) Reusable packages are disinfected in accordance with food safety at each use.
- (6) Full packages can weigh a maximum of 30 kg.
- (7) The provisions of the third, fourth, fifth and sixth paragraphs of this article may not be applicable for the packaging of pumpkin, white cabbage, watermelon, melon, potato, onion and sweet potato. In this case;
 - a) Packages for pumpkins, white cabbage, watermelons and melons are in the form of crates, boxes or baskets, in sizes suitable for pallets of 80x120, 100x120 or 60x80 cm.
 - b) Packages for potatoes, onions and sweet potatoes are in the form of nets, jute sacks, bags, crates or boxes and have a maximum weight of 50 kg.
- (8) In case the producers sell the goods they produce directly to the consumers on retail, the provisions of the second, third, fourth, fifth and sixth paragraphs of this article do not apply to these sold goods.
- (9) The packages to be used in the transportation of the goods in Annex-1 shall be suitable for the cold chain.
- (10) The relevant standards/criteria of the Turkish Standards Institution are implemented in matters not regulated in this Communiqué on the packaging of goods.

3.2.2 Transport Standards

The packaging standards in the Communiqué are as follows.

- (1) The goods included in Annex-1 are transported in the cold chain.
- (2) The goods in Annex-1 are transported by frigorific vehicles suitable for pallet use after cooling. Covered or tarpaulin transportation vehicles are used to transport these goods to the wholesale market at the production site or to the sorting, packaging or pre-cooling facility.
- (3) Covered or tarpaulin transportation vehicles are used for the transportation of goods other than the second paragraph.
- (4) During the transportation of different goods in the same vehicles, it is necessary to take measures to prevent the goods from damaging each other.
- (5) The provisions of the first and second paragraphs do not apply to the transport of goods purchased from manufacturers or wholesale markets for retail sale by retailers registered in the Union of Chamber of Merchants and Craftsmen, and goods sold directly to consumers by retailers as retail.
- (6) Vehicles and equipment used in transportation with frigorific vehicles meet the following conditions:
 - a) There are no wear, punctures or cracks on the inner and outer surfaces of the insulated equipment. No light leaks into the insulated equipment when its doors are closed.

b) There are mechanical devices that can keep the internal temperature of the insulated equipment between 0-15 °C. A tolerance of +2 °C is applied at temperature values.

c) The insulated equipment is equipped with a temperature monitor.

ç) Compliance of the frigorific vehicles with the conditions specified in this Communiqué is documented by the Turkish Standards Institution by being inspected and tested in 3-year periods.

(7) Mechanically cooled vehicles with ATP certificate of conformity are considered to meet the conditions in this article, provided that they have cooling/heating equipment and a temperature monitoring device.

(8) The relevant standards/criteria of the Turkish Standards Institution are applied in matters not regulated in this Communiqué on the transportation of goods.

(9) The authorities of the Ministry of Agriculture and Forestry are reserved in the official controls regarding the packaging, storage, transportation and retail sale of the goods in accordance with the Law No. 5996 dated 11/6/2010 on Veterinary Services Plant Health Food and Feed and the regulations prepared based on the mentioned Law.

3.2.3 Storage Standards

(1) The goods in Annex-1 are stored in cold storage. Other goods are stored in areas with suitable temperature and relative humidity that will not cause deterioration or loss of quality.

(2) The standards/criteria determined by the Turkish Standards Institution are applied for the properties of cold storages where the goods mentioned in Annex-1 will be stored and the areas with suitable temperature and relative humidity environments that will not cause deterioration or loss of quality of other goods, and the works and processes related to the storage activities to be carried out in these places.

(3) The cold storage warehouses where the goods will be stored must have a Service Qualification Certificate (TSE-HYB) according to the TS 9048 standard by the Turkish Standards Institution.

(4) The cold storage warehouses where the goods will be stored must have received an "Business Registration Certificate" from the Ministry of Agriculture and Forestry in accordance with the Law No. 5996.

3.2.4 Products to be Subject to Cold Chain Listed in Annex-1

Raspberry, blackberry, strawberry, mulberry, plum, blackcurrant, fig, pumpkin blossom, apricot, cranberry, cherry, asparagus, mango, mangosteen, mushroom, blueberry, nectarine, passion fruit, pitahaya (dragon fruit), soybean sprouts, peach, persimmon, grape, cherry, loquat, apricot.

3.3 LAW NO. 5957 ON THE REGULATION OF THE TRADE OF VEGETABLES, FRUITS AND OTHER GOODS WITH SUFFICIENT SUPPLY AND DEMAND DEPTH (MINISTRY OF TRADE)

According to Law No. 5957, it is carried out under the auspices of the Ministry of Industry and Technology and the Ministry of Trade. In addition, the Ministry of Interior and the Ministry of Agriculture and Forestry are authorized in some inspections. The Ministry of Agriculture and Forestry receives analyzes of pesticide residue from wholesale markets. Intercity roads, entrances and exits of districts are inspected by the Ministry of Interior.

Wholesale markets have wholesale market arbitration committees. Buying and selling in wholesale markets is carried out by middlemen. The product is purchased from the manufacturer with the producer's receipt and the purchase price is paid to the manufacturer by the middlemen within 15 working days. Middlemen cannot create

situations that will cause tightness in the market and cannot engage in practices that will cause prices to fall or increase. They cannot sell goods below wholesale prices, and they also cannot sell vegetable and fruit waste. Wholesale places cannot be used for any other purpose. In the markets, there are price determination commissions consisting of the members of the market middlemen association, producer unions, chamber of agriculture, chamber of commerce, union of chamber of merchants and craftsmen, and prices are determined according to the type of products that are traded that day.

3.4 MINISTRY OF TRADE REGULATION ON WHOLESALE FRUIT AND VEGETABLE MARKETS

The purpose of the wholesale markets is to keep the records of the goods that are of good quality, comply with standards and food safety, and enter under free competition conditions, to monitor, to provide common information sharing between states, to protect the rights and interests of producers and consumers. Directorate General of Provincial Trade (Director General of Domestic Trade) are authorized as the follower of these works. No more than 1 wholesale market can be established within the boundaries of Metropolitan Municipalities.

Wholesale markets should be established in the entrance and exit areas of the cities. It would be appropriate to choose the regions with easy access.

In some cases, laboratories and cold storages can be built by municipalities or the private sector.

Sorting, classifying, packaging and labeling of the goods entering the wholesale markets can also be done by the packers.

The operation of the markets is managed by the management of the market commissioners association elected by the commissioners, the general directorates of the municipalities and the wholesale market police services.

The difference between the wholesale markets in EU countries and the wholesale markets in Turkey occurs due to two reasons. The first of these is the differences in the systems and structures of the wholesale markets. The second is the lack of physical conditions (for example, cold storage rooms, restaurant, park, warehouse, packing house, etc.) that are foreseen to be located in the market complex, although they are included in the legislation in Turkey.

3.5 ISTANBUL METROPOLITAN MUNICIPALITY REGULATION ON WHOLESALE FRUIT AND VEGETABLE MARKETS

The purpose of this regulation is to carry out trade in free competition system in accordance with quality standards and food safety in wholesale markets serving under the management and supervision of Istanbul Metropolitan Municipality, to ensure the effective supply, distribution and sale of goods, as well as the rights of producers, consumers and those who take up fresh fruit and vegetable trade as a profession and protect their interests in a balanced and equal way, and regulate the professional activities of the members of the profession.

Food safety and quality analyzes are carried out in public or private laboratories authorized by the Ministry of Agriculture and Forestry. It is obligatory for the notifiers who will have the food safety and quality analysis of the goods to be declared during the notification process.

An untrue analysis report regarding the goods cannot be prepared or arranged. Products that have lost their food reliability are destroyed through the report prepared by the Rotten and Fraudulent Product Determination Commission.

The qualifications to be sought and the documents to be requested from those who operate vehicles that will be engaged in the transportation of vegetables and fruits to the wholesale market in and outside the wholesale market states are as follows:

a) Vehicles that will deliver intercity goods to wholesale markets must have cold air systems with adequate technical features. In these vehicles, the document on the measurement of exhaust gas emission and the relevant transport document should be included.

b) Those who operate vehicles that will ship goods in and out of wholesale markets must submit a photocopy of their identity and vehicle license, relevant transport document, tax plate to the Wholesale Markets Directorate. In case these conditions are fulfilled, the approved in-state transportation document is given by the State Directorate.

3.6 REGULATION ON MARKET PLACES (MINISTRY OF TRADE)

The purpose of this regulation is to ensure that the trade of vegetables and fruits, other food and necessities permitted by the municipality in these workplaces is carried out in accordance with quality standards and food safety, in free competition conditions, and to protect the rights and interests of consumers.

Market places are determined by lot by paying the occupation fee determined by the municipal councils according to the establishment plan (open or closed).

Vegetables and fruits and other foodstuffs and necessities that are allowed to be sold by the municipal committee are sold on retail in the market places. The sale of other food and necessities is carried out in accordance with the relevant legislation.

In the sale of goods, the following matters are complied with:

- a) Goods are offered for sale in accordance with food safety, quality and standard, technical and hygienic conditions.
- b) Goods that are fraudulently mixed or contrary to standards are not sold.
- c) Goods of different quality and/or less than the amount written on it cannot be placed in the same container or package.
- d) In the neighborhood markets where organic goods are offered for sale, no goods other than those certified according to the relevant legislation are sold.
- e) Inspections should be more frequent and sustainable.

4. LEGISLATION IN EU COUNTRIES

4.1 EU HYGIENE PACKAGE

4.1.1 HYGIENE PACKAGE - REGULATIONS (EC) 852, 853, 854 AND 882/2004

"The "Hygiene Package" consists of a set of European Regulations that food business operators must comply with during the production, transport, distribution and marketing of foodstuffs.

The "hygiene package" has been issued to ensure the safety of food products and therefore to protect the health of consumers.

The main European Regulations, called the "Hygiene Package", are:

- 1- Regulation (EC) No 852/2004 on the Hygiene of Foodstuffs (general requirements);
- 2- Regulation (EC) No 853/2004 laying down Specific Hygiene Rules for Food of Animal Origin (special requirements);
- 3- Regulation (EC) No. 854/2004 laying down Specific Rules for the Organization of Official Controls on Products of Animal Origin Intended for Human Consumption;
- 4- Regulation (EC) No 882/2004: on Official Controls Performed to Ensure the Verification of Compliance with Feed and Food Law, Animal Health and Animal Welfare Rules

4.1.2 HYGIENE OF FOODSTUFFS - EC 852/2004

This regulation requires food business operators to have appropriate temperature-controlled processing and storage facilities that can keep food at appropriate temperatures and enable these temperatures to be monitored and recorded. (<https://www.legislation.gov.uk/eur/2004/852/contents>)

The relevant regulation lays down general rules for food business operators regarding the hygiene of foodstuffs, taking into account the following principles:

- a) Primary responsibility for food safety rests with the food business operator;
- b) It is necessary to ensure food safety throughout the food chain, starting with primary production;
- c) It is important, for food that cannot be stored safely at ambient temperatures, particularly frozen food, to maintain the cold chain;
- d) General implementation of procedures based on the HACCP principles, together with the application of good hygiene practice, should reinforce food business operators' responsibility;
- e) Guides to good practice are a valuable instrument to aid food business operators at all levels of the food chain with compliance with food hygiene rules and with the application of the HACCP principles;
- f) It is necessary to establish microbiological criteria and temperature control requirements based on a scientific risk assessment;

This Regulation shall not apply to:

- a) Primary production for private domestic use;
- b) The domestic preparation, handling or storage of food for private domestic consumption;
- c) The direct supply, by the producer, of small quantities of primary products to the final consumer or to local retail establishments directly supplying the final consumer;

- d) Collection centres and tanneries which fall within the definition of food business only because they handle raw material for the production of gelatine or collagen.
- e) It is necessary to ensure that imported foods are of at least the same hygiene standard as food produced in the Community, or are of an equivalent standard.

A Foodstuffs Transportation Company is a Food Business Operator, therefore, all rules apply. Some notes that directly concern transportation companies are:

- It is important, for food that cannot be stored safely at ambient temperatures, **particularly frozen food, to maintain the cold chain;**
- It is necessary to establish microbiological criteria and temperature control requirements based on a scientific risk assessment;
- **General obligation** states that **food business operators** shall ensure that all stages of production, processing and distribution of food under their control satisfy the relevant hygiene requirements laid down in this Regulation.
- **Food business operators** shall, as appropriate, adopt the following specific hygiene measures:
 - Compliance with temperature control requirements for foodstuffs;
 - Maintenance of the cold chain;
 - Sampling and analysis.

4.1.3 RULES OF TRANSPORTATION

1. Conveyances and/or containers used for transporting foodstuffs are to be kept clean and maintained in good repair and condition to protect foodstuffs from contamination and are, where necessary, to be designed and constructed to permit adequate cleaning and/or disinfection.
2. Receptacles in vehicles and/or containers are not to be used for transporting anything other than foodstuffs where this may result in contamination.
3. Where conveyances and/or containers have been used for transporting anything other than foodstuffs or for transporting different foodstuffs, there is to be effective cleaning between loads to avoid the risk of contamination.
4. Foodstuffs in conveyances and/or containers are to be so placed and protected as to minimise the risk of contamination.

4.1.4 RULES ON EQUIPMENT REQUIREMENTS

All articles, fittings and equipment with which food comes into contact are to:

- a) Be effectively cleaned and, where necessary, disinfected. Cleaning and disinfection are to take place at a frequency sufficient to avoid any risk of contamination;
- b) Be so constructed, be of such materials and be kept in such good order, repair and condition as to minimise any risk of contamination;
- c) With the exception of non-returnable containers and packaging, be so constructed, be of such materials and be kept in such good order, repair and condition as to enable them to be kept clean and, where necessary, to be disinfected; and
- d) Be installed in such a manner as to allow adequate cleaning of the equipment and the surrounding area.

4.1.5 MONITORING OF THE TEMPERATURE - REGULATION (EC) 37/2005

Regulation 37/2005 concerns the monitoring of temperature in the means of transport, warehousing and storage vehicles of fast-frozen foodstuffs intended for human consumption. Monitoring and recording the temperature consists of:

1. The means of transport, warehousing and storage of quick-frozen foodstuffs shall be fitted with **suitable recording instruments to monitor**, at frequent and regular intervals, the air temperature to which the quick-frozen foodstuffs are subjected.
2. From 1 January 2006, all measuring instruments used for the purpose of monitoring the temperature, as provided for in paragraph 1, shall comply with EN 12830, EN 13485 and EN 13486 standards. Food operators shall keep all relevant documents permitting verification that the instruments referred to above conform to the relevant EN standard.
3. Temperature recording shall be dated and stored by the food operator for a period of at least one year, or for a longer period taking into account the nature and the shelf life of the quick-frozen foodstuffs.

4.1.6 RISK ANALYSIS AND HACCP

Risk analysis is the cornerstone of this system. It is about protection from chemical, physical and microbiological contaminations.

Risk analysis is done with the **HACCP method** (Critical Control Points and Hazardous Analysis).

This method is based on the evaluation of the risks at that point by determining the critical control points that carry a risk element from the enterprise.

The main points of the HACCP system are:

1. Good hygienic practice procedures;
2. Determine possible Critical Points (CP) and Critical Control Points (CCP) (flow chart);
3. Control and monitoring procedure (Sampling Plan);
4. Nonconformity management procedure;
5. Managing traceability procedure;
6. Periodic verification procedures.

These procedures are contained in the HACCP Manual.

The purpose of the HACCP Manual is to identify the elements that may pose a hazard to ensure the hygienic safety of the transported products and therefore the health of consumers, and to define criteria for determining the measures to be taken to prevent, reduce or eliminate these elements.

Each food company has different structural and production characteristics, therefore, the HACCP manual should also be "tailored" to the actual intended use and food safety guarantee.

5. SITUATION IN EU COUNTRIES

For the trade of fresh fruits and vegetables in European countries, no different regulation has been made from the EU Hygiene package. The legislation within the scope of this package does not contain any regulation regarding cold chain practices in the transportation of fresh fruits and vegetables.

Spain has also integrated ATP requirements into its national transport, mandating ATP requirements only for foods included in ATP. However, no legal regulation has been made for cold chain practices in the transportation of fresh fruits and vegetables.

France has not made a legal arrangement for cold chain practices in the transportation of fresh fruits and vegetables.

Italy is one of the most important producers of fresh fruit and vegetables in Europe and has been applying ATP requirements since 1977. However, no legal regulation has been made for cold chain practices in the transportation of fresh fruits and vegetables.

The UK, as a country that does not use ATP locally, refers to Recommended International Code of Practice for Packaging and Transport of Tropical Fresh Fruits and Vegetables issued by the FAO for the transport of fresh fruit and vegetables.

EU countries have mostly adhered to the EU acquis in their food-related regulations, and no application has been made in the transportation of fresh fruits and vegetables other than the hygiene regulations published by the EU.

6. BILATERAL AGREEMENTS

Turkey's food import and export with other countries are under control with Quarantine Agreements. Agricultural Quarantine is a set of studies that includes inspection, control, audit and other activities based on the laws, bylaws and regulations applied in the entry, exit and domestic circulation of all kinds of plants and plant-based materials, taking into account the diseases and pests that are dangerous for plant health.

Agricultural Quarantine activities in exports include controls that ensure that agricultural products to be exported to foreign countries are prepared in accordance with the quarantine conditions of the receiving country and transit countries. At the end of these controls, a Phytosanitary Certificate or Export Permit is issued. Each country has its own agricultural quarantine legislation (laws, statutes and regulations). In these legislations, there are dangerous insects, diseases, imported or conditional plants and transit provisions belonging to that country.

6.1 AGREEMENTS IN PLANT PROTECTION AND QUARANTINE

According to the information obtained from the website of the General Directorate of European Union and Foreign Relations of the Ministry of Agriculture and Forestry, Turkey has plant protection and quarantine agreements with the following countries.

Table 5 Agreements in Plant Protection and Quarantine

Agreements in Plant Protection and Quarantine				
Sıra No:	Name of Country	Date of Agreement	Place of Agreement	Name of Agreement
1	ARGENTINA	March 28, 2005	Ankara	Cooperation Agreement in Plant Protection
2	AZERBAIJAN	June 30, 2012 September 28, 2021	Baku Ankara	Agreement in Plant Protection and Quarantine Cooperation Agreement on Food Safety
3	BELARUS	March 2, 2005	Minsk	Cooperation Agreement in Plant Protection and Quarantine
4	ALGERIA	May 15, 1998	Ankara	Cooperation Agreement in Plant Protection
5	KINGDOM OF MOROCCO	March 30, 2005	Rabat	Cooperation Agreement in Plant Protection and Quarantine
6	CROTIA	February 10, 1999		Cooperation Agreement in Plant Protection
7	FRANCE	November 9, 1990	İzmir	Protocol in Plant Protection
8	IRAQ	October 15, 2009	Bagdad	Memorandum of Understanding on Cooperation in Plant Protection and Quarantine
9	PERSIA	April 25, 2003	Ankara	Cooperation Agreement in Plant Protection and Quarantine
10	ISRAEL	September 16, 2003	Tel Aviv	Cooperation Agreement in Plant Protection and Quarantine
11	ITALY	May 07, 2015	İstanbul	Memorandum of Understanding on Phytosanitary

12	CUBA	November 04, 2003	Havana	Cooperation Agreement in Plant Protection and Quarantine
13	MACEDONIA	October 02, 1998	Skopje	Cooperation Agreement in Plant Protection and Quarantine
14	EGYPT	November 18, 2012	Cairo	Cooperation Agreement in Plant Protection and Quarantine
15	MOLDOVA	June 04, 2003	Ankara	Cooperation Agreement in Plant Protection and Quarantine
16	UZBEKISTAN	April 06, 2021		Agreement Between the Government of the Republic of Uzbekistan and the Government of the Republic of Turkey on Cooperation in the Field of Plant Quarantine
17	PAKISTANI	December 07, 2010	Ankara	Cooperation Agreement in Plant Protection and Quarantine
18	RUSSIAN FEDERATION	January 13, 2010	Moscow	Cooperation Agreement in Plant Quarantine
19	SYRIA	December 23, 2009	Damascus	Memorandum of Understanding on Cooperation in Plant Protection and Quarantine
20	TUNISIA	January 27, 2001	Tunusia	Cooperation Agreement in Plant Protection
21	UKRAINE	December 22, 2011	Ankara	Cooperation Agreement in Plant Protection and Quarantine
22	CHINA	October 22, 2018	Ankara	Memorandum of Understanding in Plant Quarantine

Table 6 Countries to Sign Agreements in Plant Protection and Quarantine

Countries to Sign Agreements in Plant Protection and Quarantine			
Sıra No:	Name of Country	Name of Agreement	Description
1	JAPAN	Memorandum of Understanding on Cooperation in Plant Quarantine	Draft text was prepared and sent to Japan via USAGM.
2	SUDAN	Cooperation Agreement in Plant Protection and Quarantine	Negotiations between the two countries continue.
3	KAZAKHISTAN	Cooperation Agreement in Plant Protection and Quarantine	The revised draft was sent to the ABDGM by working on the text submitted for opinion.
4	JORDAN	Cooperation Agreement in Plant Protection and Quarantine	Efforts in this regard continue.
5	KYRGYZSTAN	Cooperation Agreement in Plant Protection and Quarantine	Efforts in this regard continue.

Turkey implements strict controls in its exports and imports with the countries that have agricultural quarantine agreements, however, in some cases, the buyer countries can allow the import of products without getting too caught up in the details of the agreement. Turkey strictly abides by the rules in the export of fresh fruits and vegetables, especially to Europe. All cold chain transports are used except for exports to Russia and Ukraine. In Russia and Ukraine, due to the lack of trucks owing to the problems of transit documents, exporters are directed to open ships, therefore, most of the transports in the winter months are made by tarpaulin vehicles to the port and

then by ships that can carry palletized cargo to Russia. This situation naturally causes more losses in products, as a solution to this, exporters have started to prefer cold chain container transportation day by day. As it is known, the active substances used in the EU are re-evaluated by the EU over the toxicological studies of the active substances and as a result of these evaluations, the active substance is included in the safe list or not used.

The fact that drugs not used by the EU are used in Turkey causes problems during the export of fresh fruits and vegetables. When residual products related to drugs not used in EU countries are released, our exported product is sent back. In order to prevent the exported products from being sent back, the drugs determined by the EU delegation as a result of the investigations in Turkey are prohibited by the Ministry of Agriculture and Forestry.

Production in the discipline of Good Agricultural Practices, which will be a solution to the important problems of our country's fresh fruit and vegetable exports such as variety, quality, pesticide residue, and will allow our country to sell more products to developed European countries, needs to be quickly adopted by our producers and exporters. Due to the conscious use of pesticides and the fact that the residues are not within acceptable limits, there are problems especially in exports to the EU. It is necessary to encourage the manufacturer to produce products that do not contain pesticide residues regarding these problems.

Bilateral Agreements are the sine qua non of fresh fruit and vegetable trade between countries. In order expand to more markets and increase our competitiveness in the international market, new agreements should be made with countries that are not on the lists.

7. INCLUDING DOMESTIC TRANSPORTATION OF FRUIT AND VEGETABLES IN THE SCOPE OF ATP-BTB

7.1 ASSESSMENT OF THE CURRENT STATUS

The current situation of our country and European Union countries in packaging, storage and transportation has been evaluated in detail above.

There is no obligation to register in the wholesale of vegetables and fruits in the EU, and such an arrangement is considered contrary to both the EU's competition rules and the competition legislation in the member states. Businesses operating in cases in the EU distribute their goods to small tradesmen who do not have the opportunity to directly supply the product they need. In wholesale markets in the EU, not only fresh vegetables and fruits are wholesaled, but also separate venues are allocated for wholesale products such as meat products, dry food, bakery products, basic necessities and even fresh flowers. For this reason, wholesale markets in EU countries are called Wholesale Food Markets. In the wholesale markets in the EU, there are warehouses and cold storages that will ensure the safest storage of products. Services such as cleaning and security are provided by private companies in wholesale markets in the EU. The wholesale markets are located and organized in a way that allows all kinds of vehicles to enter and exit easily.

Although fresh fruits and vegetables imported in the European Union are not checked by food inspectors in terms of the HACCP (Critical Control Points and Hazardous Analysis) system, having this document makes it powerful. Large retail groups in the European Union have gathered the minimum standards required for agricultural products grown in their own countries or imported from abroad, under the name of GLOBALGAP, in order to ensure the consumption of healthy and high quality products. Today, the certificate in question is accepted and required by large chain stores in the EU. In addition, GLOBALGAP encourages the implementation of the HACCP system and supports its principles.

There are many directives that contain very detailed standards and hygiene conditions for all necessities and especially foodstuffs. These conditions apply to products both imported and produced in the EU domestic market. All quality, standard, hygiene and calibration controls of products imported from countries outside the EU are carried out at customs. Thus, non-standard products are prevented from entering the domestic market. Compliance control is carried out for all goods coming from countries outside the EU. If most of the products imported from third countries do not comply with the standards, the coordinating authorities of the relevant countries are informed.

ATP includes the standards set for the international transport of perishable foodstuffs. ATP stipulates that special equipment should be used for the transportation of the foodstuffs in question and that these equipment should have ATP certificate, however, ATP is not a directly effective international agreement. The main area where the ATP legislation differs from the relevant provisions of the Turkish legislation is the establishment and operation of control and sanction mechanisms in order to ensure the effective implementation of ATP in EU countries. In order for the ATP agreement to be fully implemented, it is necessary to have a sufficient vehicle fleet and cold storage warehouses for all domestic and international transportation. France, Italy, Spain, Portugal, Slovakia and more recently the Russian Federation have adopted ATP for national road transport. France, Italy and Spain are the countries that implement the ATP best.

Market patterns for agricultural products in the European Union are handled within the scope of the Common Agricultural Policy (CAP). The objectives of the CAP can be classified as improving production standards and technology, ensuring the effective use of agricultural production tools, increasing agricultural productivity within the EU, ensuring stability in the markets, ensuring supply and food security in products, providing stability in employment and ensuring the economic and social welfare of the producer with an environmentally compatible mode of production. When the policies implemented in Turkey are evaluated according to the EU, in Turkey, it can be concluded that;

- The number of actors in the marketing channel is high and the efficiency of the producer is weak,
- The future strategy for fresh fruit and vegetable market regulation and the related macro objectives and implementation plans are not clear,
- There are many institutions and organizations in market regulation, control and auditing is difficult,
- There is an insufficient marketing-oriented producer organization,
- Agricultural finance system cannot meet the needs of the fruit and vegetable sector,
- There are inadequacies in packaging, packaging, logistics and facilities,
- Manufacturers do not have full awareness of quality and standards.

However, when evaluated in general, the fresh fruit and vegetable sector in Turkey has record speeds in logistics, vegetables harvested in our southern provinces can be delivered to markets and markets in Istanbul after an average of one day. Thanks to this high speed, the products reach the market before they have a chance to rot. However, as a result of any delay that may occur in sales in the market, it is inevitable that the products will immediately deteriorate. As a precaution, frigorific vehicles are also used when necessary (in hot months) for products that deteriorate more quickly than other products and have a higher economic value compared to other products.

7.2 ATP-BTB FOR MANUFACTURERS AND RETAILERS

The Ministry of Trade determined the standards to be followed in the wholesale and retail trade of vegetables and fruits with the Communiqué on the Standards to be Followed in the Wholesale and Retail Trade of Vegetables and Fruits published in the Official Gazette dated 29 June 2021. With this Communiqué, the procedures and principles regarding the standards to be complied with in wholesale and retail trade of goods were determined in accordance with the Law No. 5957 on the Regulation of Trade of Vegetables, Fruits, and Other Goods with Sufficient Supply and Demand Depth. With this Communiqué, the certificate of conformity to be given by both ATP and TSE is accepted for certain products, and in a way, the expanded national version of the ATP will be put into use. However, when looked at the market, there is not any preparation in the manufacturers, a similar situation was experienced in the law enacted in 2017, everything remained only in writing and could never be put into practice. Manufacturers are far from fulfilling even many of the obligations currently in force. The most effective factor in the harmonization process here will be control.

The necessity of applying cold chain in fresh fruits and vegetables is a must in all agricultural engineering books, however, the implementation in many countries in the world is similar to ours. Fresh fruits and vegetables are somewhat more resistant to exposure to heat since they are not perishable foods, as mentioned before. This pushes manufacturers and retailers to lower cost systems. Selling fresh fruits and vegetables without using cold chain causes food loss at certain rates. When the same product is examined as a frozen product, a frozen product whose cold chain is broken both poses a great food safety risk and full loss can occur.

Another reason why fresh fruits and vegetables in Turkey can be sold with relatively little damage compared to other countries without a cold chain is a very fast supply process. Harvested in important production cities such as Mersin or Antalya on the first day, the product is packaged in no time, loaded on trucks the same evening, and can take its place on the market shelves of big metropolises such as Istanbul and Ankara the next morning. The capacity to deliver the product to the end user in a shorter time than the time for the products given in the report to be placed in the cold chain after harvest keeps retailers away from the cold chain. Therefore, it is estimated that fresh fruit and vegetable retailers will resist the cold chain obligation today and in the future, as they have in the past.

7.3 ATP-BTB FOR HAULIERS

ATP and BTB implementations and documents mostly bind hauliers. In international transportation, all hauliers strictly comply with the ATP, which is already in force, if the countries they carry are ATP members and carry out inspections. However, since fresh fruits and vegetables are out of the scope of ATP, they do not need to show compliance in this regard, however, as mentioned before, international transporters are ready for the transition to ATP legislation as of the trucks in their fleet.

Considering domestic transportation, since fresh fruits and vegetables are not currently transported by cold chain, the existing vehicle fleet will never be sufficient if all fresh fruits and vegetables are covered. The gradual inclusion of fresh fruits and vegetables will cause a great deal of chaos since a very small portion of the shipment of fresh fruits and vegetables in Turkey are currently made by frigorific vehicles. This change will force all hauliers to make new investments, and therefore will cause an increase in freight prices. These investments may be the sanction of completely new frigorific vehicles, or they may only be by replacing the superstructure of existing vehicles with refrigerated cases.

Pre-cooling, which is an indispensable part of cold chain transportation, will be impossible in the current fast logistics system without increasing the number of facilities that can provide this service. This will mean that the products loaded without cooling will try to be cooled in the trucks, which will do more harm than good to the product. The product, which is tried to be cooled during transportation, will not reach the desired temperature at the destination, and if it is not taken to the cold storage at the unloading place, the product will age and decay faster due to transpiration.

It is essential that the cold chain is set up correctly and not broken, so it should be ensured that it progresses in a total systematic, since only inclusion of fresh fruits and vegetables in transportation may damage the product, otherwise, although the current transports without cold chain are unhealthy, they will cause less loss than a badly established cold chain order. The use of frigorific vehicles should not be considered before the number of pre-cooling and storage facilities reaches sufficient capacity. Considering the products currently covered by ATP, the system applied for products in circulation in the Turkish market is a good example. A frozen product must be cooled down to the transportation temperature when leaving the factory, and if necessary, it is kept at the same temperature during the period between production and transportation. Due to the structures of such facilities, even the corridors between storage and loading are cooled so that the product does not melt due to heating in a short time. When the product arrives at the distribution warehouse after being transported in a healthy way, it is either transferred from the vehicle to the vehicle in an air-conditioned environment or placed in the cold storage. This process is carried out until the product reaches the final producer on the market shelf. Similar processes have to be carried out even in fresh products (such as meat, fish, chicken) that seem to be relatively less sensitive to temperature changes than frozen products. The only difference is that in fresh warehouses (+grade enclosures) there is little need to cool the aisles. Considering these services, the experience of the logistics sector in Turkey is complete, however, it does not have the capacity to serve fresh fruits and vegetables.

7.4 FINANCIAL IMPACT ANALYSIS IN CASE OF AN ATP-BTB IMPLEMENTATION IN FRUIT – VEGETABLE TRANSPORTATION

In this section, the additional costs and benefits of cold chain domestic transportation of fruits and vegetables and the necessity of ATP-BTB certificate will be examined. For this, 3 products were identified and the analysis was made on the basis of these products.

The products to be analyzed were identified as tomatoes, peaches and lettuce/iceberg, which have an important place in our country's fruit-vegetable trade. The reason for choosing these products is that the harvest dates for tomatoes and peaches are mainly summer months and there is a requirement for cold transportation. Lettuce, on the other hand, was chosen as it is a perishable product that is of great benefit in cold transportation.

The assumptions made for the analysis are listed below:

- In a study commissioned by Metro Wholesale Markets to TUBTAK, the loss rate of vegetables and fruits during transportation was found to be 10%¹⁶. In this analysis, 10% for tomato and peach and 13% for lettuce will be used¹⁷.
- It is assumed that the transportation will be made in Mersin wholesale markets- Ankara wholesale markets.
- The transportation prices given in the tables are the current data from Mersin wholesale market.

The cost calculation and product loss comparison for 20 tons of tomatoes to be transferred from Mersin wholesale market to Ankara wholesale market are available in the table below.

Table 7 Comparison of conventional and frigorific transport for Tomatoes and Peaches

Mersin wholesale market – Ankara wholesale market 20 ton truck	Conventional (non frigorific vehicle)	Frigorific vehicle
Unit transportation cost (TL/kg)	0.4	0.70
Total transportation cost (TL)	8,000	14,000
Loss rate	10%	0%
Tonnage lost (10%)	2000	0
Average wholesale market price of tomatoes in 2021 (TL/kg)	1.65	-
The value of loss for tomatoes (TL)	3.300	-
Average wholesale market price of peaches in 2021 (TL/kg)	5.00	-
The value of loss for peaches (TL)	10.000	-

As can be seen from the table above, while the additional cost of cold chain transportation of tomatoes is 6,000 TL, the benefit from the reduction in product losses is 3,300 TL. In this case, the benefit of transporting by frigorific vehicle lags behind the additional cost and, if necessary, the additional cost will be reflected in the product prices.

Again, as can be understood from the example above, the price of the transported product is an important factor affecting the result. For instance, the result varies when looking at a more expensive product such as peaches. The average price of peach in 2021 is 5 TL/kg. Since the transportation conditions for tomatoes and peaches are similar, the costs will be almost the same. However, the cost of 2 tons of product, which is considered lost, is 10,000 TL this time, which is above the additional cost of 6,000 TL for cold transportation. This time, the benefits outweigh the costs. It can be concluded that cold chain transportation should be preferred if the transported product is valuable (in this example, the threshold value is 3 TL/kg).

A similar analysis was carried out for a bulky but low-weight product such as lettuce. In this case, only 10 tons of lettuce can be loaded on a truck that can carry 20 tons of tomatoes. While the transport cost per kilogram is slightly higher, the overall transport cost is lower. Since the truck will be light, it will use less fuel and travel the same distance at less cost than carrying 20 tons of product. It was assumed that the loss would be 13%, since lettuce is less heat resistant.

¹⁶ Improvements in Logistics and Food Chain, TÜSiAD-T/2020-03/617, M. Tanyaş, A. Tektaş

¹⁷ 29 March 2017 Agriculture Summit, Kubilay Özerkan General Manager of Metro Wholesale Market

Table 8 Comparison of conventional and frigorific transport for lettuce

Mersin wholesale market – Ankara wholesale market 10 ton truck	Conventional (non frigorific vehicle)	Frigorific vehicle
Unit transportation cost (TL/kg)	0.5	0.88
Total transportation cost (TL)	5,000	8,750
Loss rate	13%	0%
Tonnage lost (10%)	1.300	0
Average wholesale market price of lettuce in 2021 (TL/kg)	3	-
The value of loss (TL)	3,900	-

In the example of lettuce, the additional cost of cold chain transportation is 3,750 TL, while the benefit from the reduction in product losses is 3,900 TL. In this case, the benefit of transporting with a frigorific vehicle exceeds the additional cost of transportation.

As can be understood from the analysis above, the feasibility of switching to the cold chain in fruit and vegetable transportation varies according to the product, the price of the product and the loss rate.

7.5 NECESSITY OF APPLYING ATP

In the detailed report of the UN in 2020, many countries in the world were examined, but there is no data about Turkey in this research. It is known that most of the existing information is not very reliable. In the light of reliable data obtained only from high-income countries, the distribution of food waste is as follows, assuming that Turkey is in this group, similar figures should be taken as a basis.

Table 9 Distribution of food waste

Average Waste of Food (per person per year)		
Domestic	Food Service	Retail
67-79%	22 - 26%	11 - 13%

As can be seen from all these loss studies, the loss of fresh fruits and vegetables in packaging, storage and transportation varies between 11-13%. In all this loss, only the effect of transportation could not be seen, and no specific study could be found. These studies have not been carried out in terms of fresh fruit and vegetables, however, generally, similar statistics can be used. Considering from this point of view, it will be seen that the main loss in fresh fruits and vegetables is not in logistics, but in homes and restaurants.

Losses in the retail sector occur in packaging, storage and transportation, and it is not known in which area these losses occur. The most basic feature of the cold chain is that it is a chain and any malfunction that may occur anywhere in the chain can collapse the whole process and result in failure. If a product that is transported in very good conditions with pre-cooling after all packaging processes, then transferred to another vehicle in a cold storage and sent to the supermarket, waits there for a long time at a different temperature, all the effort will be wasted. Since the problems that occur at the beginning of the chain will spread to the rest of the process, for instance, a fruit that has not been pre-cooled regularly may spoil before it reaches the markets.

In any case, the life of a product without a cold chain will be shorter than a product kept and transported in a cold environment. If a product is loaded into a cold truck without being cooled and unloaded, it is processed again at ambient temperature, which will also damage the product and shorten its current life. As the product cools down and heats back up, it will cause transpiration and more water loss, which will cause quality losses, weight loss and

rapid rot in the product skin. Therefore, applying the ATP rules only in the transportation of fresh fruits and vegetables will do more harm than good. Applying ATP rules would only make sense in an overall cold chain implementation that includes storage, packaging and sales networks.

With the Communiqué on the Standards to be Followed in the Wholesale and Retail Trade of Vegetables and Fruits by the Ministry of Trade, some products have been placed in the cold chain, therefore, the transportations related to them must be arranged.

7.6 SUGGESTIONS

The issue of food safety and reducing food losses has become an increasingly important and sensitive issue for consumers. At this point, its application in the fields of production, packaging and marketing in all agricultural products produced in the world is an indisputable concept. Food safety, the traceability of which is ensured by the quality systems created in various links of the food production chain, has made a significant progress in agricultural production, which forms the basis of the food raw material source. However, due to the high investment costs in Turkey, quality systems and well-equipped vehicles are unfortunately not accessible to everyone in the sector. Agricultural production and logistics infrastructure should be expanded and developed with support.

The fruit and vegetable production and exports will gain momentum thanks to the developments to be achieved in safe agricultural production and product processing in Turkey and it will be possible to obtain and process safe products in foreign and domestic markets. Products that can be sent to Europe and that have a passport will be able to take their place in elite markets as “reliable products that do not carry the risk of drug residues”. Supermarkets operating in Turkey approach the matter with increasing rigor and offer their customers systems that show that the products on their shelves are reliable in the production and processing stages.

In addition to the importance of agriculture as the production link of the food chain, it is important to ensure continuity in order to be a building block of a wide-ranging and future-oriented food system, providing efficiency and using technology to respond to current needs. In this context, besides the effective use of infrastructure and technology, it is also very important for manufacturers, especially small-scaled ones, to be aware of these developments. At this point, the efficiency of agricultural extension and education services has a great role in providing efficiency.

A traceable production and logistics system should be implemented in order to make the best use of the potential of our country, to ensure the food safety of our people, increase the share of our country in the world market by providing a competitive advantage in foreign markets, to increase export opportunities, to solve the problems experienced permanently, as well as not to keep our producers under suspicion and not to damage our country's reputation. In this regard, the main recommendations are as follows;

- ISO 22000 is a standard for food safety management systems and should be implemented. These methods include storage, packaging and transportation.
- Loss of water, which causes deterioration in products, manifests itself in the form of wilting and wrinkling. Many fruits and vegetables may experience 5% weight loss, therefore, it is important to follow the cold chain.
- It will be possible to determine the load movements with roadside inspection station data.
- The number and quality of cold storages in Turkey are insufficient. Their number needs to be increased.
- The government should increase its support for frigorific vehicles and cold storage, and incentives should be effectively supported.
- Setting and applying standards for domestic vegetable and fruit transportation will prevent losses.
- When we look at Turkey's fresh fruit and vegetable exports, it will be important to determine the most intense periods of transportation and to make logistics plans accordingly; Cherry, Sour Cherry, Grape, and Apricot are the most exported products in the June-November period. Pomegranate, Apple, Quince,

Strawberry are the most exported products in the period of December-May. Tomato, Potato, Onion, Cucumber, Gherkin, Pepper are the most exported products in vegetable exports between December and June. Between October and March are the periods when citrus exports are made. Tangerine, Lemon, Orange are the most exported citrus products. October-February is the period when we export citrus fruits to Russia and Ukraine. Between April and June, our citrus exports are directed to the Gulf countries.

- It is obligatory to transport the pre-cooled products by frigorific vehicles. After fresh fruits and vegetables are pre-cooled, they are transported by frigorific vehicles suitable for pallet use.
- It is necessary to carry out transportation in cold storage conditions, to regularly monitor the temperature monitoring of frigorific vehicles, to choose suitable packaging for the product, to keep cold air inventories, and to support quality-oriented objectives.
- Cold chain related articles may not be applied in the transportation of melon, watermelon, pumpkin, white cabbage, potato, sweet potato, and onion.
- If the products are transported to the enterprise, to the wholesale markets at the production site, to the sorting and packing facility, they can be transported by closed or tarpaulin vehicles.
- Fresh fruits and vegetables should not be transported together as they have different storage conditions. Products that absorb strong odors such as peppers and green onions should be handled and transported separately with citrus fruits.
- These provisions do not apply to products purchased from wholesale markets or manufacturers for retail sale by retailers.
- It is obligatory to have a registration certificate and a service adequacy certificate to be obtained from TSE in cold storage warehouses. (Ministry of Trade)
- Sector components should hold regular workshops in order to determine the dimensions of the problems faced by the products in domestic and international transportation.

REFERENCES

- FAO, CodexAlimentarius, RECOMMENDED INTERNATIONAL CODE OF PRACTICE FOR PACKAGING AND TRANSPORT OF TROPICAL FRESH FRUIT AND VEGETABLES, CAC/RCP 44-1995
- FAO, CodexAlimentarius, CODE OF HYGIENIC PRACTICE FOR FRESH FRUITS AND VEGETABLES CXC 53-2003 Adopted in 2003. Revised in: 2010 (newAnnex III forfreshleafyvegetables), 2012 (newAnnex IV forMelons), 2013 (newAnnex V forBerries), 2017.
- Fransa Cumhuriyeti, Hayvansal kaynaklı ürünler dışındaki gıda maddeleri ile bunları içeren gıda maddelerinin perakende ticareti, depolama ve nakliye faaliyetlerinde uygulanacak sağlık kurallarına ilişkin 8 Ekim 2013 tarihli Kararname, <https://www.legifrance.gouv.fr/loda/id/JORFTEXT000028081402/2021-12-21/>
- Cemafröid, Fransa, ATP, http://www.autoritecompetenteatp.cemafröid.fr/index_en.htm
- MINIMUM QUALITY SPECIFICATIONS FOR FRESH FRUIT AND VEGETABLES, 2020, UNECE, <https://unece.org/trade/wp7/FFV-Standards#c55288>
- “What requirements must fresh fruit or vegetables comply with to be allowed on the European market?”, Ministry of Foreign Affairs, UK, 17 March 2021, <https://www.cbi.eu/market-information/fresh-fruit-vegetables/buyer-requirements>
- Yaş Meyve ve Sebze Çalıştayı, Konya 12-13 Haziran 2019 / Selçuk Üniversitesi, TAGEM <https://www.tarimorman.gov.tr/TAGEM/Belgeler/Duyurular>
- Dünya'da ve Türkiye'de Yaş Sebze ve Meyve Üretimi, Ankara 23.01.2017 / Ankara Ticaret Borsası https://www.ankaratb.org.tr/lib_upload
- Tarım ve Gıdada Rekabetçi Üretim, Ankara 2018 / Kalkınma Bakanlığı On birinci Kalkınma Planı <https://www.sbb.gov.tr/wp-content/uploads/2020>
- Gıda Zincirindeki Hasat Sonrası Kayıpları Azaltmak için Yenilikçi Yaklaşımlar, POSTHARVEST 2018 <http://www.postharvestproject.com/uploads/outputs>
- Bahçe Bitkilerinde Hasat ve Pazarlama <https://avys.omu.edu.tr>
- The Journal of International Social Research/HISTORICAL PROGRESS AND CURRENT STATE OF HIGHWAY TRANSPORTATION IN TURKEY WITH RESPECT TO TRANSPORTATION GEOGRAPHY, Issn: 1307-9581 Erol Kapluhan <https://www.sosyalarastirmalar.com>
- Tarım ve Gıdada Rekabetçi Üretim / Özel İhtisas Komisyonu Raporu, Ankara 2018 / Kalkınma Bakanlığı On birinci Kalkınma Planı <https://www.sbb.gov.tr/wp-content/uploads/2020>
- TARIM VE GIDA LOJİSTİĞİNDE İYİLEŞTİRMELER, Prof. Dr. Arzu Tektaş Prof. Dr. Mehmet Tanyaş, Mart 2020, Yayın No: TÜSİAD-T/2020-03/617, TÜSİAD
- Meyve ve Sebzelerde Ön İşlemler / Ankara Üniversitesi (Açık Ders)
- Ambalajlama Malzemeleri, ANKARA 2011 840UH0037 M.E.B. http://www.megep.meb.gov.tr/mte_program_modul/moduller_pdf
- Journal of Architectural Sciences and Applications Research article JASA 2021, 6 (1), 59-76 e-ISSN: 2548-0170
- Genel Bahçe Bitkileri, Ondokuz Mayıs Üniversitesi TMP112 / Doç. Dr. Ahmet ÖZTÜRK <https://avys.omu.edu.tr/storage/app/public/ozturka/94852>

Sebze ve Meyvelerin Toptan ve Perakende Ticaretinde Uyulması Gerken Standartlar Hakkında Tebliğ, Resmî Gazete 29 Haziran 2021 Sayı:31526 Gıda Tarım Bakanlığı / Bitki Koruma Müdürlüğü

Taze Meyve Sebzelerin Üretim ve Hasat Sonrası Aşamalarının Hijyen Esasları Uygulama Kılavuzu, Gıda Tarım ve Hayvancılık Bakanlığı Kılavuz No: 11

Meyve Sebze İşleme ve Depolama Tesis Ön Fizibilitesi 2017, DOĞAKA www.dogaka.gov.tr

Sebze ve Meyvelerin Toptan ve Perakende Ticaretinde Uyulması Gereken Standartlar Hakkında Tebliğ, Resmî Gazete 29 Haziran 2021 Sayı:31526

Gıda Güvenliği 2018 Öğr.Gör.Dr. Engin Yaralı <https://akademik.adu.edu.tr/myo/cine/webfolders>

Türk Gıda Kodeksi Hızlı Dondurulmuş Gıdalar Tebliği TEBLİĞ NO: 2014/47 Sayı: 29149

OHS ACADEMY 3(2), 30.08.2020 ISSN: 2630-578X <https://doi.org/10.38213/ohsacademy.740235>

Süreç Ölçümleri Dilsad Engin / Ege Üniversitesi 2/22/2015 Türk Standardı (TSE) TS EN 13486

Foodwaste in Europe: “statistics and facts about the problem”, 12.09.2021, EUFIC

UNEP Food Waste Index Report 2021, 04 March 2021, UN Environment programme

Depolama Nedir, önemi ve Depolama Aşamaları, Ankara Üniversitesi Açık Dersler, https://acikders.ankara.edu.tr/pluginfile.php/19422/mod_resource/content/0/Konu%201.pdf

Meyvelerin Muhafazası, Tarım Kütüphanesi, http://www.tarimkutuphanesi.com/meyvelerin_muhafazasi_00469.html

ZİRAİ KARANTİNA BİR ULUSAL GÜVENLİK KONUSUDUR, BASIN AÇIKLAMASI, 14 Ocak 2021, TMMOB ZİRAAT MÜHENDİSLERİ ODASI, İSTANBUL ŞUBESİ https://www.zmo.org.tr/genel/bizden_detay.php?kod=34339&tipi=3&sube=3

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Applications of Cold Chain Logistics and Swot Analysis of Cold Chain Logistics in Turkey, DİCLE ÜNİVERSİTESİ SOSYAL BİLİMLER ENSTİTÜSÜ DERGİSİ

Avrupa Birliği ve Türkiye’de Yaş Meyve ve Sebze Pazarlama Sistemleri, Kızılaslan, H.; Yalçın, A. / Sosyal Bilimler Araştırmaları Dergisi. II, (2012): 119-140

<https://www.tarimorman.gov.tr/ABDGM/Menu/74/Anlasma-Ve-Protokoller>



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