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BEST INNOVATIVE APPROACH TO MINIMIZE POST HARVEST LOSSES WITHIN FOOD CHAIN

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Sales Conditions in Retail and Wholesaler Market Training Material

CENTRAL RESEARCH INSTITUTE FOOD AND FEED CONTROL

TURKEY

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1. INTRODUCTION

"Best Innovative Approaches to Minimize Post Harvest Losses within Food Chain "project is supported by the Ministry of the European Union and it is carried out under the coordination of Central Research Institute of Food and Feed Control in Bursa. Project stakeholders are General Directorate of Agricultural Research and Policies (TAGEM), Gaziantep University (GU), Bursa Metropolitan Municipality (TARIMAS) and Bursa Commodity Exchange (BTB) from Turkey. Overseas stakeholders of the project are Food Canning National Technology Center (CTC) from Spain, Dunarea De Jos University (UDJ) from Romania and Food Association (IFA) from Austria.

The project aims to reduce post-harvest losses and to improve the quality, safety, and marketability of selected horticultural products by developing a training package that meets vocational training needs of employees in post-harvest sectors (food supply chain).

"Sales conditions in retail and wholesaler market training material" aims to increase the vocational qualifications of staff working in of fresh fruits and vegetables retail and wholesaler markets. The researches reveal that undeveloped and developing countries are experiencing significant loss of fresh fruits and vegetables during and after the harvest as well as growing. It has been reported that there are also losses during transport, storage and marketing. For this reason, the studies and the materials prepared for reducing the losses from farm to table are very important.

Globally, the importance that consumers give to health and healthy food is increasing day by day. Undoubtedly, fruits and vegetables have a significant place in healthy and balanced nutrition. For this reason, fruit and vegetable production and marketing have become important in terms of an adequate and balanced nutrition of the increasing population.

The word marketing derived from the word market (Kızılaslan and Yalçın 2012). In general, marketing is a concept that encompasses the integration of the entire internal market such as organization, price, and financing as well as costs, activities, services and laws that regulate them. In summary, marketing is the identification, evaluation and estimation of demands; the increment and activation of the demand and the determination of the consumer needs and the direction of the sales and distribution of the goods and services demanded (Alpkent, 1995).

The marketing of agricultural products includes activities that enable agricultural products to move from the places of production to places of sale and then to consumers. During the marketing stage, the product should be of good quality, and it should be produced in sufficient quantity and at low cost to ensure the highest customer satisfaction.

Agricultural marketing is a system that covers the entire stages of agricultural products from production to consumption. It ensures delivering of products without any loss to the consumer, presenting the products to the market in a good condition and it is effective on the producers and consumer incomes, and therefore it highly effective in the country's economy (Dere, 2006). Consumers are forced to pay a high price for fruit and vegetable products and fruit and vegetable producers have a small share of the sales value compared to many other products due to quite long marketing channels and high labor demand (Akbat *et. al.*, 2005).

Agricultural marketing channels vary from country to country because each country's agricultural production structure, nutritional habits and consumers' demands are different from each other. Marketing channels of agricultural products show differences from product to product and from region to region in Turkey (Anonymous, 2010). Mostly in developing countries, vegetable and fruit enterprises are small family businesses so producers do not have an efficient structure in the marketing of their products. Roughly, in fresh fruit and vegetable marketing, products are changing at least two channels and the number of distribution channels may reach about five. Apart from the direct sales from producers to consumers, the least handover is seen in cooperatives, industry and export purchases. Besides these channels, traditional fresh fruit marketing channels are occurred as "Producer-Wholesaler-Retailer-Consumer" (Demirbas, 2001). Fruits and vegetables are perishable products and 25-35% of them are wasting during marketing stage due to the defects in the marketing chain. It is possible to reduce this loss up to 10% with consistent marketing policies. Policies covering fruit and vegetable growing are important in terms of preventing the losses.

Fruit and vegetable products are significant agricultural products and have a significant share in the national economy. The fruit and vegetable industry is made up of many products with different characteristics. It is emphasized that the problems caused by production as well as the problems related to marketing are important in the studies of fresh fruits and vegetables and these problems should be solved. With this training material prepared within the scope of the project, it is aimed to give information about reduction of losses especially in the retail

and wholesale stages of fruits and vegetables and to increase the vocational qualifications of the people working in these sectors.

2. FRESH FRUIT AND VEGETABLE MARKETING IN TURKEY

Fruits and vegetables can be processed with various technologies or stored for a certain period of time after they have been picked or they are immediately served for consumption. It is necessary to keep these products in the proper freshness and shape desired by the consumer. In its simplest form, marketing is the process of delivering of products from producer to the consumer, and the examination of events that have taken place in the meantime. According to official statistics of Turkey, an average of 13 million tons of fruit is produced annually from 35 fruit species. Marketing ensures reaching the goal of production. Day by day, the free market economy is becoming more widespread and crucial in Turkey. For this reason, the marketing is one of the important sub-sectors of the country. The product that the manufacturer produces by using the production factors such as land, labor, capital and entrepreneurship can only find its real economic value when it reaches to the consumer with a good marketing system so that it benefits both the producer and the consumer.

Significant problems are encountered in delivering fresh fruit and vegetables from producer to consumer. More care and technical knowledge are needed in the marketing step of these products since they are quickly spoiled. For this reason, it is important to increase the level of consciousness of target population with the training materials that will be prepared. Some producers can market their products by selling them to the commissioners at the production site when the production site is far from the market or the shipping cost is too much. Commission agents market the products which they bought to retail and wholesale distribution channels and from there they are transported to the market, supermarket and groceries. Producers can also market its products directly to agricultural cooperatives and exporting firms. Another marketing channel is that fruits and vegetables reach retailers through agricultural cooperatives. The relatively longest line of fresh fruit and vegetable marketing channel is "producer-collector-commission agent (at the production site)-wholesaler-commission agent (at the consumption site)-retailer-consumer" (Polat 2010). However, fresh fruit and vegetable marketing is mostly done in wholesaler store.

2.1. Types of Purchasing

Firms purchase fresh fruit and vegetables daily or every other day. Purchasing of products is carried out through commission agent and merchant. In standard quality, products that do not contain chemical substances are included in market demands. Higher rayon losses (may reach 30%) have occurred in local department stores. Necessary precautions have been taken to keep these losses at 5-7% level in hypermarkets. Firms only carry out cleaning, classification and packaging processes in their own warehouses for their own markets.

Problems arising from physical processes such as marketing, packing, storage etc., as well as the excess number of handover in agricultural products and irregularities in distribution cause large amount product losses. The primary intermediaries in the producer area are; brokers, middleman, merchants, commissioners, producers and cooperatives (Anonymous, 2017a).

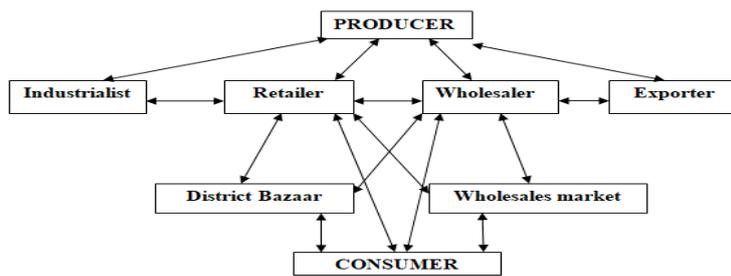


Figure 1: Fruit and vegetable marketing channels in Turkey

A large number of firms indicate that they purchase fresh fruit and vegetables on a daily basis. The preferred model for the purchase of fresh fruits and vegetables by the companies is to deliver them to the branch offices via central procurement (54.5%). Purchasing from wholesales market takes place on the top with % 63.6 share. Local merchants or brokers appear in other models used. These preferences vary depending on the product groups or product characteristics. Differences on purchases made directly by the companies have been identified when the packaging property of products is examined. In direct purchases made from producers; packaged, classified and cased products are wanted. The types of packaging used for the delivery of centrally purchased products to branch offices are given according to the products in the table (Table 1). Retailers take the product at a lower price from the production area and bring it to the consumption zone. This leads to a decrease in income of commissioners, traders and city hall in the consumption area.

<i>Product</i>	<i>Packaging Type</i>
<i>Apple</i>	Case
<i>Banana</i>	Cardboard box
<i>Melon</i>	Case
<i>Cherry</i>	Case
<i>Orange</i>	Case
<i>Mandarin</i>	Plastic netting
<i>Lemon</i>	Cardboard box
<i>Strawberry</i>	Case
<i>Kiwi</i>	Case
<i>Tomatoes</i>	Case
<i>Pepper</i>	Case

Table 1: Type of packaging used for transport from the center

Modern retailers try to achieve a specific product standard by cleaning, sorting and packaging in the process of delivering the product to the consumer. However, this is valid for a limited number of products. Retailers have performed large centralized procurement purchases, both at the center and at the branches. Firms with central purchases make large purchases from the producer region, some of the deficiencies are completed from the consumption center where the retail branch is located. In developed countries, modern retailers seem to have met most of their fresh fruit and vegetable needs from producers, producer cooperatives or packaging houses. When the product is directly flowed from the producer to the retailer, its impact on price formation is reduced. Warehouses have a bigger share in fresh fruit and vegetable marketing organization. In general, it is stated that 76% of the vegetables are marketed in warehouse organization.

3. EUROPEAN UNION'S FRESH FRUIT AND VEGETABLE MARKETING AND APPLICATIONS

In the European Union (EU), great importance is attached to the delivery of fresh, safe and healthy products to consumers and necessary measures are being taken according to the unique structure of vegetable-fruit production and trade. EU COFEL (European Union of the Fruit and Vegetable, Wholesale, Import and Export Trade) established in the EU structure carries on a business related to EU price mechanism, export incentives, quality standards, hygiene rules, customs taxes, packaging and packaging wastes, support funds, information exchange. EU COFEL intends to increase consumption of fresh products on the EU market and to improve the contribution of fresh product consumption to healthy living.

Regulation No. 2200/96 on Fruit and Vegetable Joint Market Regulation and Regulation No. 1148/2001 on Compliance with Fresh Fruit and Vegetable Marketing Standards constitute the main framework in the trade of fresh fruits and vegetables in the EU. Apart from these two regulations, there are also a number of directives and regulations on the trade of fresh vegetables and fruits. Lastly, with the reform in 2013, a new regulation (dated December 17, 2013 and No. 1308/2013 of the Common Market Regulatory Authority for Agricultural Products, which abolished Council Regulations No 922/72, 234/79, 1037/2001 and 1234/2007) European Parliament and Council Regulation) come into force. In this regulation, the structure of the previous regulation has been preserved and intervention, private storage, import tariff quotas, export returns, protection measures, state aids and competition rules has been rearranged according to the tools or policy subjects used (Anonymous 2018).

Regulation No. 2200/96 on Fruit and Vegetable Joint Market Regulation contains 4 basic items;

- * Classification of fresh vegetables and fruits and establishment of standards,
- * Establishment of producer organizations,
- * Intervention arrangements,
- * Trade with third countries

Regulation No. 1148/2001 Regarding Compliance with Fresh Fruit and Vegetable Marketing Standards is;

- * Determination of the authorized institution to perform quality standard inspections,
- * The creation of the merchant database,
- * Performing domestic compliance controlling,
- * Checking compliance of import and export quality (Özsu, 2005).

In order to prevent unfair competition in agricultural products within the EU and to ensure the formation of market prices, regulations have been introduced that require all producers to market their products with producer associations to which they are affiliated. First-hand wholesale sales of products, whether imported or marketed by producer associations, are carried out principally through auction sale. Supermarkets and hypermarkets prefer buying directly from producer associations. Generally, manufacturers' associations carry out auctions on the channel of cooperatives which they build. All of the manufacturers' associations have superior associations and branch associations. In the EU market, supermarkets and

hypermarkets have gained a great deal of importance in marketing almost all basic necessities, especially food items. The auction is the preferred method of product supply by smaller-scale wholesalers since these companies buy and/or import products they will market directly from the manufacturer's unions. The products brought to wholesale food markets are mostly bought by businesses such as small grocery stores and restaurants. It is also possible for final consumers to buy products from these locations, provided they are wholesale. In EU countries, there is no obligation to enter wholesale markets for fresh vegetables and fruits.

Fresh vegetables and fruits are generally delivered to retailers from three channels:

- (1) Wholesale,
- (2) Large distributor markets,
- (3) Manufacturer associations.

From these, large distributor markets can do wholesale and retail distribution. Vegetable and fruit wholesaler, retailer, distributor and packer in the European Union are responsible for the labeling of all products that they sell. If the product is unlabeled and the buyers receiving the product accept it in this way, they are responsible for labeling the product. In EU, three separate minimum marketing criteria (extra class, first class and second class) are determined for vegetables and fruits. Each product package must be labeled as legible and visible. It is compulsory to add information related to packer, product type, country, quantity, class on the label (Vural, 2009).

In the EU, there is no obligation to be registered for wholesale of vegetables and fruit. Such an arrangement is considered to be contrary to the competition rules of the EU as well as the competition legislation of member countries. Businesses operating in the EU distribute their goods to small tradesmen, which lack the ability to directly procure the goods they need. Wholesalers in the EU do not only sell fresh vegetables and fruits, but also allocate separate spaces for wholesale of meat products, dry food, bakery products and basic necessities. For this reason, wholesale markets in EU countries are called wholesale food markets. In the EU wholesale market, there are warehouses and cold air warehouses to ensure that products are stored in the healthiest way. The rental/sale, transfer or withdrawal of the workplaces are arranged in a very simple and clear manner by their own rules.

Apart from wholesalers, importers, commissioners, food and beverage suppliers also operate in wholesale food markets. In these wholesalers, some services such as cleaning and security can be carried out by private companies. The wholesaler markets are arranged and organized so that all kinds of vehicles can be easily entered and exited. The purpose of establishment of producer associations in the EU is to ensure the good operation of the Common Market Regulations (OPD), which is the heart of the common agricultural policy. Also, the producers' associations aim to provide food safety in agriculture and to raise the producer income to a reasonable level. It is expected from the producer associations that they should be voluntary producers that produce environmentally friendly products that are suitable for the purposes of the common market schemes. The meaning of voluntariness here can be explained as a natural need that the efficient operation of the market requires (Anonymous, 2010).

4. REASONS FOR LOSSES AT RETAIL AND WHOLESALE LEVEL

Nearly 25% of the fruit and vegetable production is deteriorated owing to deficiencies or non-existence of marketing organizations and their perishable structure. Modern retailing can be defined as a service line that has a consumer-centered policy, institutionalized, attaches importance to staff training and service quality, and provides direct product flow between producer and consumer. Chain stores located within modern retailers are defined as groups that are connected to a single center, whose activities are controlled from a certain extent centrally.

Retailers have a say in the actions in the supply chain as they decide on the quality of the product to be offered and exhibit it in their display cases. In addition, temperature, humidity, lighting conditions and transportation applications affect the quality, shelf life and acceptability of the product. Most of the losses in the retail phase are experienced in perishable foods like vegetables, fruits, fish and seafood, meat, dairy products and cooked foods.

In many developing countries' markets, sellers are pouring unclean water on fruits and vegetables in order to prevent sunburns. These practices cause buyers to buy unsafe foods and then to throw them away. At many retail outlets, fresh foods are displayed to attract consumers, and they are allowed to choose the product they want from them. Consumers are able to buy food at different stages of ripening but this opportunity causes high losses. For

example, the products at the bottom of the baskets are crushed by the weight of the top products. In addition, exhibiting different types of food together in different maturation processes reduces the shelf life of foods due to different ethylene production. Lastly, while consumers are mixing baskets, they damage products. The desire to present the best food to consumers in color, shape, and type has led retailers to set high standards for their products. Rejection of products that do not meet these standards during delivery is one of the main causes of food losses (Oral, 2015).

The causes of product losses during marketing can be listed as follows;

1. Low fruit quality
2. The condition of climatization in market and sales environment
3. Over-stocking of products at supermarkets and sales points
4. Power cut
5. A poor procurement plan that leads to buying more foods than needed or buying a food that is not needed immediately;
6. Disposal of currently available food due to not knowing the difference between the recommended consumption date and expiration date,
7. Inappropriate storage in the home environment or poor inventory management
8. Cooking more food than you will consume
9. Reduced nutrient value and loss of quality due to poor food preparation techniques
10. Not knowing that leftovers can be used to prepare other foods
11. Market owners and staff engaged in the sale of fresh fruit and vegetables are not trained about reducing losses.

In developed countries, direct sales in the fresh fruit and vegetable marketing chain have come to the fore with modern retailers. Products often flow into markets called contract manufacturing, where they reach consumers. When sales forms of fresh fruits and vegetables are examined in the stores, it is seen that several systems are used together in order to meet consumer preferences. In 25% of the companies, all of the products were offered in bulk form. However, in other firms, the sales in bulk form ranged from 60 to 90% and for the remainder, stretch film coated packages were used in different sizes. The aim is to reduce product losses by protecting the products from touching and choosing.

Applications in the fresh fruit and vegetable sections, especially those connected to the spilling system, cause product losses. Although the losses vary according to type of product, it has been understood that the local markets are not able to show sufficient diligence about the prevention of losses.

Measures taken by firms to prevent quality and product losses are:

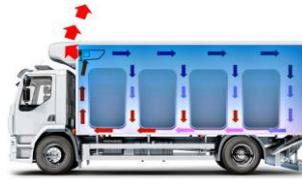
- Careful monitoring of cold air systems (33.4%),
- Compliance with the standards set by the firm (22.2%),
- Abandonment of deep spilling systems (11.1%),
- Cleaning of the rayon, rejection of poor quality products as well as the removal of disruptive injurious substances (33.3%).

All of the companies have a separate unit responsible for the purchase of fresh fruit and vegetables. While 5% of firms indicate that they purchase fresh fruit and vegetables on a daily basis, 1 firm makes a purchase every other day. The model preferred by firms to purchase fresh fruit and vegetables is to deliver product to the branches via central procurement (54.5%). Purchasing from warehouses is in the first place with 63.6% within central procurement. Among the other models used for central purchasing are local trader or their own commission agents. These preferences vary depending on the product groups or product characteristics.

In the fresh fruit and vegetable marketing organization, there are differences in the location and the importance of the various units. In the market of fresh fruits and vegetables, unorganized intermediaries such as collectors, local intermediaries, sellers, and traders who supply products to the district markets and the exporter are played an important role. In vegetable marketing, warehouses are getting bigger share. Vegetable producers generally express that 76% of the vegetables are marketed in the warehouse organization, although various regions are encountered at different rates for different species (Pezikoglu et al., 2004).

5. TRANSPORTATION OF PRODUCTS FROM PRODUCTION AREA TO PACKAGING IN AN APPROPRIATE CONDITION

Firstly, fresh fruits and vegetables must be transported in the suitable transport vehicles. For the protection of the cold chain, the products should be transported in the cold chain depending on the species. The temperature in the vehicles must be adjusted according to each product. The temperature must be traceable on refrigerated vehicles. The refrigerated vehicles should be checked by competent authorities. Different product groups that may harm each other should not be transported together. When mixed transportation will be carried out with different product groups, the product groups should be selected by considering their transportation temperature. Also, various effects like odor, ethylene should be considered in the selection of these product groups. Fresh fruits and vegetables must be transported and stored under conditions that will minimize microbial, chemical or physical potential contamination. Transport vehicles should not be used for transporting dangerous goods without adequately cleaned to prevent cross contamination.



6. MAINTENANCE AND SANITATION IN FRESH FRUIT AND VEGETABLE SECTOR

Effective sanitation in food production begins with the provision of "good, high quality, clean, microbiologically safe, raw and adjuvant material suitable for consumption". As a result of the use of poor quality raw materials, auxiliary substance and additives:

- The operations performed are insufficient.
- Prevents production of foods in desired quality.
- Causes economic losses

Almost all of the physical, chemical and biological hazards that can be found in foods begin with the plant and animal growing stages in the field and farm.

The field or farm where the raw material is grown can be a source of contamination. A safe option for raw material supply is to work with reliable producers as a preliminary contract.

Contracts,

- Not cultivating on roadside fields,
- Ensuring that irrigation water and irrigation system used are hygienic,
- Including the use of approved pesticides at appropriate doses that will not leave residues.

With the "Safe Supplier", the applications that will remove the various risks posed by agricultural raw materials are guaranteed by the supplier himself. Food producing enterprises must know the properties of raw materials they use (in terms of ingredients, additives, and chemicals), quality criteria, where, when, how and how much of these materials are used and must keep track of all these aspects.

The procurement department of the firm should periodically apply the necessary quality and safety criteria for each input. All raw materials received should be inspected and the necessary controls should be done periodically. Food producing enterprises have to prepare procedures related to the raw materials and the supplier companies must comply with these procedures and certify that the raw material that is delivered is processed in hygienic conditions. Once the supplier has passed hygiene audit successfully, an "Eligible Supplier" certificate should be given.

In addition to procurement of raw materials and additives from reliable suppliers, some preliminary reviews and controls should also be carried out in their acceptance into operation. These:

- Only clean, fresh and desired raw materials should be taken into operation and materials not meeting specified specifications should not be admitted.
- Large volumes or packaged ingredients and additives should be screened, filtered or passed through metal detectors before admission

Buildings and harvesting equipment should be kept under conditions that would facilitate repairs and disinfection. The equipment must be designed to prevent contamination of fresh fruits and vegetables. Cleaning programs, cleaning and disinfection programs must be established and implemented. The effectiveness of cleaning and disinfection systems should be monitored and reflections of changing conditions, regularly monitored, should be adapted to the program. For example; harvesting tools and equipment, and reusable containers should be cleaned and disinfected regularly within a certain program. Particular attention should be given to the cleanliness of the harvesting equipment, which is in contact with the fresh fruits and vegetables not washed before packaging.

6.1. Pre-Production Hygiene and Sanitation Rules: The production of a high quality and safe product in the food industry can be happened by applying a suitable technology as well as a suitable sanitation program for the operation. In a quality and healthy production, environment and employees should be clean and healthy, respectively. In addition to this, tools, equipment and all surfaces should be cleaned and disinfected periodically. Food enterprises must check whether the tools and equipment are ready for production, cleanliness and hygiene before starting production.

The purpose of a sanitation program is to provide a clean and sanitary environment for the handling of food products. This program must provide cleaning and sanitizing of all food handling equipment and each area of the facility in a timely manner. It is essential that this program be designed to accomplish this objective and remain economically feasible while it meets or exceeds all of the regulatory requirements. The program must be written with all of these goals in mind. If any of these goals are not met, the program will be destined for failure. The sanitation program must include four basic steps. The first step is to assign a plant sanitarian. The second and third steps are to establish written cleaning procedures and schedules. Last step is to document sanitation inspections (Brent, 2006).

7. HEALTH AND HYGIENE OF EMPLOYEES IN FOOD SECTOR

Hygiene; is a health science and aims to protect and maintain health. All practices applied to be protected against health-damaging environments and sanitary measures taken are defined as hygiene.

Personal hygiene; are self-care practices that people apply to protect and to maintain their own health. Foodborne diseases are widespread in the world. Food may be exposed to various contaminations during the stages of the production-consumption chain. For this reason, it is possible to reduce the number of food-borne diseases by giving necessary care to the food establishments. Many foodborne diseases are caused by lack of hygiene concerns of personnel, contamination during production and consumption, or incorrect heat treatments. The personal hygiene of an individual who has a physical contact with the food, has a crucial role in preventing foodborne illnesses. Personnel hygiene includes washing hands and cleaning of other body parts that may be in contact with food. In addition, health of employees, lack of germ carrier, use of gloves and caps are also included in personnel

hygiene. Approximately 20% of foodborne outbreaks caused by inadequate personnel hygiene of infected individuals who are in contact with foodstuff. Adequate hygienic measures must be taken in establishments to prevent foodborne illnesses.

Factors affecting personal hygiene;

1. Age,
2. Sociocultural and economic situation,
3. Knowledge,
4. Personal preferences,
5. Physical condition,
6. Body image (the individual's mental image of his/her physical appearance).

Purposes of hygiene practices;

1. To remove secretions, faeces and microorganisms secreted from the body
2. To provide relaxation of an individual
3. To reduce muscle tension
4. To remove the unpleasant smells from body (smell of sweat)
5. To make the general appearance of the individual positive and increase one's self-confidence
6. To maintain and improve skin health (For example, warm and hot baths can deeply nourish skin by increasing the blood circulation in skin).

Food Safety: It is the concept that when food is prepared and consumed in accordance with intended use, it would not harm the consumers. Food safety is associated with presence of hazards and does not involve subjects other than human health (malnutrition etc.).

Food chain: It is the sequential steps and processes which are from the first production and consumption of a food including processing, storing, transporting, loading and unloading

Food Safety Hazard: The biological, chemical and physical factors of a food or a food condition that may cause adverse health effects.

Possible Dangers/Hazard: Theoretically possible damaging potentials. The term **danger hazard** should not be confused with risk. The term **danger-hazard** depends on the likelihood of adverse health effects (such as sickness) and the severity of this effect (death, treatment, absence of work, etc.) when exposed to a safety hazard in the field of food safety.

Commented [GS1]: This is the definition of risk

Risk: It is defined as the likelihood of harm and resultant of the severity of this harm in ISO / IEC 52.

Hazard Analysis: The process of collecting and evaluating information about the hazards and the conditions that lead to their existence, in order to decide which hazards are important for food safety and thus need to be addressed in the HACCP plan.

Critical Control Point: The steps that control is compulsory or can be implemented to prevent or eliminate or reduce food safety hazards to acceptable levels.

Food Hygiene: A list of precautions to be taken at all stages of the food chain in order to serve food items as safe to consumption.

Hygiene Rules: Health precautions that would be considered at all stages from the production to consumption of food and additives, and the health rules that will be applied by the personnel. HACCP is a food product safety system that is based on determination of the necessary hygiene conditions in food establishments for healthy food production (personnel hygiene, equipment hygiene, raw material hygiene, environment hygiene, etc.) and meeting these conditions. It also includes determination of factors that could be health risk for consumers in production and service stages. HACCP is an abbreviation for Hazard Analysis and Critical Control Points. The system is a systematic approach that allows for the identification and control of the hazards that affect product safety in advance.



The HACCP consists of the generally accepted seven basic principles

1	Hazard analysis and the creation of detailed flow charts
2	Determination of Critical Control Points using the Decision Tree
3	Determination of target levels and tolerances at each critical control point
4	Establishment of appropriate monitoring methods to keep critical control points under control
5	Determination of "Corrective Actions" to be applied against non-compliances and deviations found during monitoring of Critical Control Points
6	Determination of Verification Procedures to prove the effectiveness of HACCP studies
7	Creation of Documentation Structure for this principle and applications

HACCP Handbook;

If a facility is required to issue a certificate after the establishment of the HACCP system, it may be necessary to prepare a HACCP handbook to include all information, such as information, procedures and references about the system. A HACCP handbook should include:

1. HACCP plan introduction page
2. Organization chart
3. Food safety policy
4. Food safety objectives
5. Scope of the HACCP system to be certified
6. Duties, authorities and responsibilities
7. HACCP team
8. Product

9. Process information

10. Hazard analysis and risk assessment

11. Quality control points, attention spots, critical limits, monitoring system, recording and corrective actions

12. Verification system

13. References to other used systems (SSOP, ISO 9001 etc.) and HACCP related procedures in these systems

14. Appendices

7.1. Acceptance and Storage Hygiene

Acceptance of Goods: Products which are not at suitable temperature, are expired, bug-infested, dirty, and faulty in the appearance and taste, and have defective package should never be accepted.

Storage;

- The storage temperature of the products should be appropriate.



Figure 2. Storage area

- Storehouses should be kept clean and tidy.
- The products should have the expiry date tags
- Care must be taken that the product is not expired.
- Attention should be paid that there is no rotten, faulty packaged, rusty, uncovered, etc. product in the storehouse.
- There should be no foreign material in the storehouse (personnel uniform, wooden material, cleaning material, etc.).
- The material should not be stored in the wooden crates in the storehouse.

7.2. Personnel Hygiene

General rules;

- Standardised personnel uniform must be worn according to the task.
- Uniforms should always look clean and smooth.
- Dirty personnel uniforms should be kept closed out of kitchen and storage areas.
- The nails should be short, clean and without nail polish, and brushed during every washing.
- Uniforms should be clean and tidy (no pens, pens, notebooks etc. in pockets).
- Shoes and slippers should be clean.
- The appearance of the personnel should be in accordance with hygiene rules (hand nail cleaning, suitable haircut and clean hair).
- Personnel health examinations and checks should be done properly.
- Dressing rooms should be clean and tidy.
- The toilets, floor and walls should be clean and odourless and the flush should be working.
- Dirty clothing and equipment should be located in a controlled place.
- Hands should be disinfected with disinfecting liquid soap before starting work and after work, when work bench is changed, after breaks, using toilet, using tissue, coughing and sneezing, touching grounded and packaged material, touching hair, face, ear, etc., touching raw meat, vegetable, etc., before touching ready to eat food and portioning and serving food.
- Personnel who has respiratory tract infections and injuries on their hands and arms should consult a doctor. The wounds should be covered.
- Personnel gloves should be used correctly at the appropriate places of use.

7.3. Raw Material Hygiene

- Small grain vegetables (peas, beans, okra) should be placed on a flat tray and sorted before thawing.
- The vegetables should be washed in a large amount of cold water and drained before cooking.
- Sensitive products such as strawberries, blackberries, cherries can be taken to production directly following sorting.

- Block vegetables (such as spinach) should be thawed in a cold room at +3, +4 degrees the day before the process and should be washed in a large amount of water after thawing and drained. Vegetables taken on a flat tray should be sorted and carefully examined for foreign substances (Tanir, 2015) (Figure 2).

Detection of indicator microorganisms at the shelves where ready-to-eat foods are sold is important for the risk of cross-contamination. Therefore, it is necessary for both large scale companies and medium and small scale sales points to fulfil the requirements for HACCP system, and establish and maintain the cleaning and disinfection programs considering personnel and equipment hygiene in the retail sector that serves the final consumption.



Figure 3. Hygiene without touching

Product ripening criteria should be considered to determine the harvest time. Products should be harvested with a blunt scissors during the harvest and fruits at appropriate ripening should be picked. In terms of weather conditions, harvesting should not be done during dew and rainy weather. In addition, precautions depending on strain and variety should be taken as soon as possible against physiological and pathological deterioration that may occur in the product. It is necessary to have air flow while stacking the products in boxes. In order to achieve

effective and rapid cooling in storage operations, product containers or packages must be correctly packaged, installed and stacked (Figure 3).

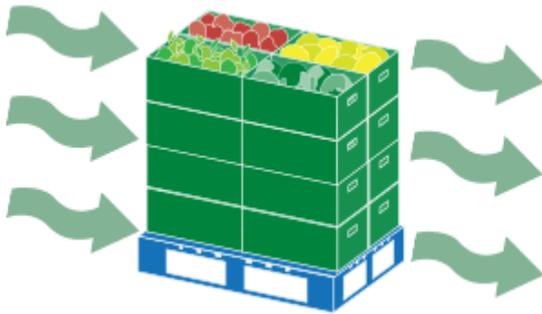


Figure 3. Stacking of fruits and vegetables and temperature control

One of the important consideration is the prevention of cross-contamination. Effective measures should be taken to prevent cross contamination from agricultural inputs and by the personnel who are in contact with fresh fruits and vegetables during primary production and post-harvest operations. Manufacturers, harvesters and other agricultural workers should pay attention to the following points to prevent potential cross contamination. Additional control measures may be required against any local factor (e.g. bad weather conditions) that may increase the risk of contamination during harvest. Harvesting should not be done in rainy weather. Physically damaged and non-homogenous fresh fruits and vegetables should be removed during harvest to prevent possible contamination at later stages.

Fruit and vegetables should be protected from physical damage such as throwing, falling, squeezing. Harvested fresh fruits and vegetables should not come into contact with the soil. Fruits that have been harvested from lower parts of the plants that are close to the soil should be collected and labelled separately to prevent cross contamination. Agricultural workers should not use the harvest equipment for any purpose other than harvesting (e.g. lunch, carrying material or fuel). Firstly, the equipment and utensils used for potentially hazardous materials (e.g. garbage, chemicals, fertilizers, etc.) must not be used to carry fresh fruits and vegetables. Equipment that is not adequately cleaned and disinfected should not be in contact with packaging materials used for fresh fruits and vegetables.

During the collection and in the case of being put into the boxes of fresh fruits and vegetables in the primary production areas, the contamination of the fertilizers and animal feces with food contact materials must not be allowed (Anonymous, 2017b).

8. TRACEABILITY AND RECORDING

Traceability is defined as the ability to trace the history, application or location of that which is under consideration. It also enables trading partners to follow products as they move from field through to retail store or food service operator. Each traceability partner must be able to identify the supplier and customer of product. The first priority of traceability is to protect the consumer through faster and more precise identification of implicated product. This is critical if the product must be withdrawn from the supply chain. For this process, first the company must determine the products that would be traced. There must also be agreement between trading partners on what the traceable item is. Otherwise, the chain would be broken. Secondly, all traceable items must be uniquely identified and this information is shared between all affected supply chain partners. In addition, all supply chain parties must systematically link the physical flow of products with the flow of information about them.

The main components of the scope of agricultural policies followed for the fresh fruit and vegetable sector in Turkey are manufacturer organizing, agricultural publishing and consulting, marketing and price formation, investment and credit arrangements, farmer registration system, food safety and traceability and foreign trade regulations.

9. STORAGE

The aim of all methods applied in the preservation of food is to prevent or limit microbiological and enzymatic changes. Microorganisms causing microbiological deterioration are rendered ineffective by killing or even if they stay alive, conditions that prevent their proliferation and activity, are provided in various preservation methods. Since sliced fruits and vegetables are products that are ready to eat, able to maintain freshness and high in nutritional value, they have started to take place in the production sector and their usage by consumers has become widespread. Colour is an important quality measure for these products, since they tend to browning quickly on cut surfaces. Thus, it has to be controlled during process in food industry. Browning affects properties such as taste, aroma and shelf life negatively in fruits and vegetables.

Freshness and colour, which are important quality measures for fruits and vegetables, change very rapidly during the preparation of the products. Since physical damage occurs as the fruits and vegetables are cut, oxygen directly interacts with them. Therefore, the methods and storage conditions, such as storage temperature, applied during the preparation of the products are important factors in terms of product quality. Different methods are applied to prevent browning in sliced fruits and vegetables. Cold chain is an effective method to reduce the quality losses and must be applied. Freezing can preserve the freshness fully, but it causes loss in the texture.

Modified atmosphere packaging (MAP) reduces the oxygen content in the package by blocking food's contact with the outer environment. This phenomenon helps to protect the quality of the freshly sliced products by creating a suitable atmosphere for them in terms of increasing the rate of carbon dioxide. In particular, when the light-coloured fruits such as bananas, apples and peaches are stored in the cold environment after slicing, the enzymatic colour browning generates. When they are packaged in the modified atmosphere, the enzymatic browning decelerates, but tissue fragmentation and quality loss cannot be completely prevented. One of the alternative methods, sulfhydryl-containing amino acids application can inhibit the formation of brownish colour components. However, when they are applied in high amounts, they affect the sensory quality of fruits and vegetables negatively. The high amount of sulfide application causes bleaching of the colour on the surface of the product, while high application costs limit its usage.

As a result of all the researches and applications carried out in order to keep foods fresh and prolong shelf life, the need for preservatives which are harmless to human health, natural and extending the shelf life of the products without causing any change in sensory properties have become prominent. Therefore, natural and organic products, which have become the preference of consumers in the last years, have been preferred by the manufacturers to protect their products and to provide healthy products to consumers. The main purpose of preserving the food as durable is to prevent deterioration and most importantly to minimize the changes in quality, nutritional value, colour, flavour and physical structure. Foods are stored using different methods to ensure their consumption at later times than their production and at different locations than they are produced. This contributes to adequate and balanced nutrition by reducing economic losses. In addition, products that are likely to deteriorate can be exported by these preservation methods.

Market stores are another area where product losses occur. However, the losses in the market stores are considerably lower than the losses in the departments. It has been determined that store losses are on average of 1-5%. The losses seen in the departments vary according to the company. These ratios are 4-30% in apple, 2-20% in banana, 5-25% in citrus, 4-35% in tomato and 4-5% in other vegetables. All of the companies have a separate unit responsible for the purchase of fresh fruit and vegetables.

Storage of packaged fruit and vegetables in cold weather conditions and preservation of them without breaking the cold chain according to product type should be maintained.

- To minimise the microbial growth, products that will be stored should be transferred to the appropriate storages without waiting and in time periods that will not affect the product quality.
- The temperature and humidity of the cold storages should be controlled, maintained at the same value and recorded.
- Inner parts of the cooling systems must be kept sanitary.
- Products should be placed in storages by classifying them based on product groups.
- Condensing vapour and defrosting water should not drip from the cooling system onto fresh fruit and vegetables.
- Products should not be stored under refrigeration systems in cold storages to prevent water condensation or water leak on the product.
- When stacking in storage, the storage capacity should be considered and the product should be piled so as not to obstruct circulation of cold air and not to prevent the application of cleaning plans.
- It is necessary to leave certain intervals between the pallets and the walls in order to ensure a smooth and fine air flow through the storage. The gap between the walls and products and the ground clearance should be such as to provide adequate air flow.
- Degraded or toxic products should be kept in separate area in storages and labelled with defined labels that would not allow them to be confused with other products. Otherwise, they should be disposed of immediately.

- The stocking method and stocking settlement in the storage should be based on the first-in first-out rule.
- Preparation areas should only be used for product preparation and not for product storing.

For cold storages, there must be a generator in order to prevent heat loss in case of power cut. In addition, isolation must be provided to prevent heat loss in cold storages. There should be no gap, when the doors are closed. Plastic curtains should be used at the storage door to prevent sudden heat loss, when the door is opened. The cold air storage should be designed so that the temperature difference at different locations of the store does not exceed ± 1 °C. For this purpose, a data logger should be provided at different locations of the storage and the temperature should be checked at certain time intervals on the basis of product characteristics. It should be checked regularly that storage humidity is suitable for the product stored and all data should be recorded. The sensors of the thermometers that measure the storage temperature should be located a few centimetres away from the wall. The thermometers in the storage must be calibrated at regular intervals.

9.1. Storage Conditions

9.1.1. Tomato



Temperature is the most important factor affecting the rate of physiological changes of biochemical and microbial activity in stored fruits and vegetables. The temperatures right above the freezing points of the fruits and vegetables are generally considered as suitable for storage. In the case of an increase in temperature, respiration rate and microbial activity demonstrate a regular increase which lead to a rise in ripening and aging rate. The

temperature of the harvested product should be reduced to storage temperature as soon as possible and this period should not exceed 12 hours.

Preservation requirements and periods of tomatoes change according to ripening levels and varieties as shown in Table 2 (Karaçalı, 2009). While the data given in the chart are general values, there are also different statements of researchers for different varieties.

Table 2. Storage requirements and preservation periods for tomato

Ripening level	Storage temperature (°C)	Storage relative humidity (%)	Preservation period
Green ripe	12-15	85-90	3 weeks
Pink ripe	7-10	85-90	10 days
Red ripe	2-5	85	5-6 days

It is generally recommended that concentration of 3% CO₂+ 4% O₂ is applied in controlled atmosphere storage of tomato (Karaçalı, 2009). The easiest way of preserving products by changing the composition of atmospheres during cold storage is preserving in modified atmosphere (in other words, in special plastic bags). In this system, the products are placed in special plastic bags with gas permeability and then preserved in cold storages. Modified

atmosphere refers to the removal or addition of a gas from the environment to obtain a different atmospheric composition around the product than the normal atmosphere. It is aimed to decelerate the respiration in modified atmospheric packaging (MAP) applications by reducing O₂ concentration and increasing CO₂ concentration.

There are important issues to be taken into consideration in order to achieve the desired purpose of using MAP. For this reason, the requirements for MAP application in tomatoes are given below (Özcan 2015);

1. Tomatoes must first be harvested in accordance with the technique. Fruits that are not damaged during and after harvesting should be packed. Damaged fruits should be separated and not packaged.
2. After the tomatoes have been placed in the appropriate packaging, they should be pre-cooled (about 6-10 hours) while the package is open or fruits should be placed in the packages after they are pre-cooled in fruit boxes.
3. MAP bags containing pre-cooled products should be closed in such a way to prevent air intake.
4. Gas concentration should be adjusted in active MAP applications.
5. MAP packaged tomatoes in closed bags must be preserved under suitable cold storage conditions.

The application of ozone to the storage air in tomato preservation inhibits or retards moulding and spoiling, while prolonging preservation time by decelerating respiration of fruits and ethylene production. Washing tomatoes in ozonated water after harvesting also contributes to the prolongation of the life after harvest (preservation and shelf life). The transport conditions for tomatoes are as important as the storage conditions for the products presented in international markets. It is recommended that the transport temperature should be 7-8°C, the maximum transport period should be 5-7 days and the relative humidity around product should be about 90-95% for tomatoes (Türk, 2005).

9.1.2. Cherry



About 2 million tons of cherries are produced worldwide. This production is obtained largely in warm and subtropical regions, particularly in Iran, Turkey, United States, Spain, Germany and Russia. However, France, Romania and Ukraine are among the important cherry producing

countries.

Cherries must be marketed in a short period of time since they ripen in certain periods and have a delicate structure. However, big clusters generate in the marketing period. Cold storage for days or weeks becomes crucial in order to prevent this accumulation and to create price equilibrium. In this period, 23% of the produced fruit is lost which comprises loss of 8% during harvest and loss of 15% during marketing (Gunduz, 1993). This situation further reveals the importance of preservation.

Cherries can be preserved at $-1-0^{\circ}\text{C}$ and at about 80-95% relative humidity, while the storage period can be extended to 1-4 weeks depending on the variety. Besides, additional measures are required to reduce weight and storage losses during storage. In recent years, some cherry types can be stored for 6 weeks in different packages (MAP) and applications. Pre-cooling that reduces the fruits' internal temperatures to the storage temperatures immediately after harvest and fungicide applications against fungal deterioration at the same time are of great importance in reducing losses. Hence, extensive quality and quantity losses in cherries generate when suitable preservation conditions and additional measures are not provided during storage (Çağatay, 2006). Additional measures include chlorination, chemical applications and ozone application. Ozone has been used in different areas including drinking water sterilization, washing and storage of fruits and vegetables for many years (Anonim, 2000).

Ozone is commercially used to prolong the shelf life and to combat pathogens in apples, cherries, carrots, garlic, kiwi, onions, peaches, plums, potatoes and grapes (Suslow, 2001).

Controlled atmosphere which is created by using polyethylene bags can prolong storage life, but the product must be opened. Atmospheric control of at the level of 20-25% carbon dioxide or 0.5-2% oxygen helps to maintain the freshness and the bright colour of the fruit and green colour of cherry stalk during storage. The biggest problem encountered in the fresh cherry market is the cavitation on the surface. Although the main cause of that is unknown, mechanical damage is considered as the reason. Calcium application or low-pressure storage reduces cavitation on the surface.

9.1.3. Grape



The grapes are harvested and stored when they are ripened enough to eat since they do not ripen after harvesting. It also needs to be sulfurized to prevent decaying. The harvested grapes should be taken in a 'pre-cooling room' at a temperature of 4 ° C within half an hour after the harvest. Grapes should be sorted and repackaged in 4 hours at maximum. This has an extremely important effect on the storage result. The next step is to bring the grapes to a final storage temperature of -1.0 to 0 ° C and a relative humidity of 90 to 95%. It is recommended that air velocity during storage to be approximately 20 - 40 feet per minute (FPM).

Pre-cooling of the grapes which is applied immediately after harvesting (bringing to pre-storage temperature) has a great effect on the storage result. Reaching to the optimum storage temperature after only one hour may lead to net quality differences after storage and may affect shelf life. The first step of protecting post-harvest quality is the prevention of warming. Harvested grapes should be placed in a chilled room with a temperature of 4°C within the shortest possible time and no more than half an hour.

The cooled environment is a buffer chamber and the grapes either are wait or packaged in this environment. The waiting period in the buffer chamber should be limited as much as possible (maximum 4 hours). Then, the product is cooled to the exact storage temperature between -1 and 0°C. The temperature in the buffer chamber should be kept as low as possible. Cooling to a storage temperature between -1 to 0°C is managed using a flow system or cooling tunnel.

The parcels are cooled as quickly and equally as possible. Product temperature of 0°C is obtained in 10 hours (at maximum) after harvest time. During the cooling period (flow system), the monitors placed at least 4 different spots in between pallets, control quality of the cooling. Temperature monitors that prevent overcooling should be placed at spots where the product absorbs the air most rapidly. The coldest temperature is set at -1.2°C.

9.1.4. Fig



The processes during harvest and post-harvest of fig requires a special care due to the fragile nature of fresh fig fruits. The high price of fresh figs in the foreign markets allows for the provision of all necessary conditions to protect the quality. In this respect, all the care must be taken in the process of packaging, pre-cooling, storage and transportation, and the conditions of the packaging house and warehouse must be improved.

The fig type Bursa black, high quality table, yellow lop drying starts to ripen in September and lasts for 2-2,5 months. Ripening is completed in 1-3 days with an increase in the sugar rate. The fig does not continue to be ripen structurally in the store.

Pre-cooling should be applied immediately after harvesting and packaging. Because the product is being harvested at the consumption ripeness. Pre-cooling should be applied in a way that reduces the product temperature less than 5 ° C in 2-3 hours.

The most suitable storage temperature is -1/0 ° C. The relative humidity of the environment should be around 85-90%. The storage temperature must be observed, when the freezing temperature is -2.7 ° C. The storage period is an average of 10 days which depends on the type. This period is 4-5 weeks for pre-cooled Bursa Black and 2-3 weeks if pre-cooling is not applied.

Most of the storage losses are not caused by water loss. However, there are spoilages caused by damages during harvest and microorganisms.

Table 3. Fig storage conditions

	Fresh	Frozen	Canned	Dried
Temperature °C	0	-23/-18	10	0/10
Relative humidity and packaging	85-90%	Hermetic boxes	Hermetic boxes	50-70%
Storage period	7 days or less	1 year or more	1 year or more	1 year

The shelf life of fig does not exceed 1 week even at optimum conditions, 85-90% relative humidity and 0 ° C (Table 3). It can be stored for 3 weeks at 15 ° C with 15% carbon dioxide. Studies have shown that controlled or modified atmosphere which have 10% oxygen and 15-20% carbon dioxide reduce spoilage and softening, besides production of ethylene by respiration. However, as the storage is extended, the flavour of the product decreases.

The precaution against microbial spoilage during storage is rapid cooling that is applied after harvest.

As a result of the mechanical damage that occurs in the fresh fig during post-harvest period, water loss is accelerated and wrinkles and microorganism activities in fruits are increased. Ripening in fresh figs usually appears by changes in colour of fruit skin and hardness of fruit flesh. The taste of the fruit also increases close to the ripening period due to rapid sugar accumulation. Undesirable water loss and fermentations begin in the excessively ripened product. Good quality fruit must not have mechanical damage or pest damage (Carlos et al., 2000).

Packing material and shape significantly affect the quality loss of fig fruit during transportation and sales points.

- Vessels that damp vibrations should be preferred during transportation,
- It has been determined that the containers used in Turkey for fresh fig transportation cause quality loss in general. It is necessary that manufacture and employment of polystyrene containers with nests that fit with product dimensions should be widespread.

- In order to prevent displacement of the products due to vibration during transportation, it may be appropriate to place the products in the nests of the transport containers after wrapping them with a thin piece of paper. Thus, the damage is reduced by usage of the supporting material.

- The placement of the figs in a way that the ostiole becomes on top will reduce the quality loss both during transportation and at the sales point.

10. ASSESSMENT

Food loss is a serious global problem that needs immediate action. Food loss occurs along the entire food chain, including losses at wholesale and retail markets. Among retail markets, supermarkets have important roles in food chains since they are located close to the end of the food chain. Fruits and vegetables are delicate products that are subjected to a number of natural and physical sources of deterioration during the marketing process that leads to food loss. There are losses of up to 50% in fresh fruit and vegetables in the world and particularly in Turkey. For instance, we lose 25-50% of the fruits that is produced using great labour in our country by the time they are brought to consumers' table from harvest. In other words; 750,000 tons out of 3 million tons of the apples produced in Turkey are wasted. 44% of the causes are due to inadequate conditions which are from production to consumption, (Türk et al., 2015).

The majority of cold storage facilities in Turkey are deprived of technological innovations of today. As a result of this; serious losses from harvest to kitchen generate and national economy undergoes great damage. According to the studies, 10 million tons of more than 40 million tons of our fruit / vegetable production is lost during this phase. It is possible to reduce most of these losses in a very short period of time with measures to be taken urgently. First of these measures is providing transportation of fruits from gardens to markets and kitchens in the cold chain by rendering "Cold Storage Facilities" widespread, technologically-equipped and hygienic establishments.

The length of marketing channel and inadequacies of marketing conditions until fresh fruits and vegetables are reached to the consumers markets cause huge amount of losses and costs since these products are perishable. The fact that the producers are not strong and well-organized increases the dependence to the intermediaries which also raises the marketing margin.

Numerous intermediary firms operate in different positions in fruit and vegetable marketing. The most important intermediary firm in the fresh fruit and vegetable marketing in Turkey is Fresh Fruit and Vegetable Wholesalers. Activities of Wholesaler are regulated by laws.

Growing fruit market in the globalizing world increases in consideration of production, packaging, cold storage and refrigeration chain logistics (Esmen, 2008). Storage and transportation activities are of great importance due to the perishable structure and rapid deterioration of fresh fruits. Inadequacies in cold storage cause huge amount of losses. Functional policies should be produced and, more importantly, applied on storage, transportation and packaging activities. One of the most important factors in achieving sustainability in fresh fruit marketing is the shortening of marketing channels. In this way, the producer earns more, while the consumer can purchase more since he/she pays less.

Some of the fruit and vegetable losses occur directly in the customer environment in post-harvest period. It is seen in the survey results that were applied in the scope of this project that there is a need for education for both customers and employees who work in the marketing to reduce the losses which is about 1-5 %. It is of great importance educate employees in wholesale and marketing sector to adapt hygiene conditions and store vegetables and fruits in a way that would not cause waste of products.

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