UNIVERSITY OF GAZİANTEP

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A SURVEY OF THE IMPLEMENTATION OF FOOD QUALITY AND SAFETY SYSTEMS IN SMALL AND MEDIUM SIZE FOOD ENTERPRISES

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IN

FOOD ENGINEERING

BY

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A Survey of The Implementation of Food Quality and Safety Systems in Small and Medium Size Food Enterprises

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Supervisor

Assist. Prof. Dr. Ali Coşkun DALGIÇ

by

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T.C.

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To my family

ABSTRACT

A SURVEY OF THE IMPLEMENTATION OF FOOD QUALITY AND SAFETY SYSTEMS IN SMALL AND MEDIUM SIZE FOOD ENTERPRISES

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M.Sc. in Food Eng.

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In this study, a questionnaire study was done in order to find out Hazard Analysis and Critical Control Points (HACCP) and pre-requisite programs of small-sized and medium-sized food operations which about produce pistachio, bulgur and red-pepper production in Gaziantep and Kahramanmaraş. 89 questions related to production technology and pre-requisite programs which are consistent with ISO 22000 Food Safety Management Systems in addition to institutional information were asked to totally 44 institutions in this survey. Besides survey, Hazard analysis and Critical Control Points (HACCP) plans regarding HACCP principles which all of the three sectors were supposed to apply are drawn. Operations were evaluated by comparing data of the questionnaire with following, confirmation and control practices which HACCP plans need. Although all the operations completing questionnaire had the permission for production, 59 percent of them has ISO 22000, 48 percent had ISO 9000. The average applying percentage in pre-requisite programs in survey emerges as 79 percent. It was observed in evaluating control practices that there are major insufficiencies in tracing (following) methods which HACCP plans need.

Key Words: Food Safety Management System, Pre-requisite programs, HACCP, Pistachio, Bulgur, Red pepper

ÖZET

KÜÇÜK VE ORTA ÖLÇEKLİ GIDA İŞLETMELERİNDE GIDA KALİTE VE GÜVENLİĞİ SİSTEMLERİNİN UYGULANMASI ÜZERİNE BİR ANKET ÇALIŞMASI

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Bu çalışmada, Gaziantep ve Kahramanmaraş bölgesindeki fıstık, bulgur ve pul biber üretimi yapan küçük ve orta ölçekli gıda işletmelerinin HACCP ve ön gereksinim koşullarını belirlemek için bir anket çalışması yapılmıştır. Bu anket çalışmasında toplam 44 işletmeye, kurumsal bilgilerin yanı sıra, üretim teknolojileri ve ISO 22000 Gıda Güvenliği Yönetim Sistemi standardına uygun ön gereksinim programları ile ilgili 89 soru sorulmuştur. Anket çalışmasının yanı sıra her üç sektörün uygulamak zorunda olduğu HACCP prensipleri ile ilgili; tehlike analizleri, HACCP planları çıkartılmıştır. HACCP planlarının ihtiyaç duyduğu izleme, doğrulama ve kontrol etkinlikleri işletmelerden gelen anket verileri ile kıyaslanarak, işletmeler değerlendirilmiştir. Anket çalışmasında yer alan işletmelerin tamamının üretim izninin olmasına rağmen 59 % nun ISO 22000, 48 % nin ISO 9000 belgesi vardır. Anket çalışmasında yer alan ön gereksinim programlarındaki ortalama uygulama yüzdesi ise 79 % şeklinde ortaya çıkmıştır. Kontrol etkinliklerinin değerlendirilmesinde ise, HACCP planlarının gereksinim duyduğu izleme yöntemlerinde önemli bir ölçüde eksikliklerin olduğu gözlemlenmiştir.

Anahtar Kelimeler: Gıda güvenliği yönetim sistemi, Ön gereksini programları, HACCP, Fıstık, Bulgur, Pul biber

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CHAPTER I

INTRODUCTION

Meeting the needs of customers, living up to expectations and reliable food phenomenon have a huge importance in the globalizing world. Competition brings about all the developments. It has been “quality” and changes in this issue that the most important rivalry factor which affects the operations. The plants that want to maintain in the future as well has had to change constantly their point of view and approaches in order to provide customer orientation, and have seen that there is no other solution apart from the necessity of improving themselves in the philosophy of constant development. Quality is stated as the total of product features and the features that meet the customer needs.

Efforts to ensuring the food security and the preservation of quality are very importance of consumer and community health. Safe food which is made sure by fulfilling all the necessities from production to consumption and food security which is applications for safe food is a concrete strategy that is adopted universally so as to meet the health and quality expectations of consumers.

The terms ‘‘food quality’’ and ‘‘food safety’’ differ from each other from person to person. Quality has a large number of meanings including the organoleptic characteristics, physical and functional properties, nutrient content and consumer protection from fraud, whereas, safety includes the content of various chemical and microbiological elements in food. Food quality and safety take on greater scope as the global food supply evolves.

Quality has become an increasingly important means of competition on the world market. Also changes in food production and trends in consumer needs require more attention to quality assurance. Therefore food quality management is very important to meet consumer expectations on quality and safety. The number of enterprises that are adopting quality assurance systems to improve their competitiveness in the global market is continually increasing [1].

Food safety is the concept used for the expression of appropriate fabrication of food related to the usage area and being harmless for consumer when consumed. Moreover, it is a scientific regulation describing the process, preparation and storage of the food and presentation to the hazard analysis and critical control points (HACCP) system is a systematic approach used to determine the hazards related to food, identify critical control points (CCP) and get them under control. In the food industry, the HACCP program combined with pre-requisite programs (PRP) is currently.

Food safety is related to the presence of food-borne hazards in food at the point of consumption (intake by the consumer). ISO (International Organization for Standardization) specifies the requirements for a food safety management system that combines the following generally recognized key elements to ensure food safety along the food chain, up to the point of final consumption:

- interactive communication,
- system management,
- pre-requisite programmes, and
- HACCP principles [2].

In addition, some processes (documentation and record processes, internal auditing processes, etc.) applied with the ISO 9000-Quality Management System (QMS) standard can be used with the HACCP system. The ISO 22000-Food Safety Management System (FSMS) standard is being introduced as a way to organize all of these requirements. The goal is to use it as a single Standard throughout the world [2].

The Aim of This Study:

The aim of this study was to find out HACCP plans of operations by conducting questionnaire on pre-requisite programs which are pre-requisite for HACCP plan in small-sized and middle-sized pistachio, bulgur and red pepper operations. In this study, it had been tried to establish connections between procedures for HACCP plan and food safety practices. Additionally, in this survey that we had done, technology applications, control measurements and problems in production of totally 44 operations had been identified. These identified data had been evaluated in control measurement and quality control points of the process. In this study, it was also aimed at making small-sized and middle sized-food operations conscious of food safety issue and spreading quality strategy.

The principle objectives of this study;

- Evaluation of pre-requsite programmes (PRP) for pistachio, bulgur and red pepper enterprises,
- Evaluating hazard and hazard analysis according to score matrix,
- Examination of critical control points measuring the processing of pistachio, bulgur and red pepper enterprises,
- Adapting HACCP plan for food safety management system according to survey data.

CHAPTER II

LITERATURE SURVEY

2.1. Product Characteristics

2.1.1. Pistachio Characteristic

The pistachio nut (Pistacia vera L) is one of the most favorite tree nuts of the world and is widely cultivated in saline, dry and hot areas of Middle East, Mediterranean country and USA. They are commercially grown in the United States, Iran, Turkey, Syria, Greece, and Italy. It contributes substantially to the agricultural exports of some of these countries. In Turkey (2008), was exported value $26,619 (1000) of pistachio and was exported 2621 tonnes. In Iran, was exported value $532,246 (1000) of pistachio and was exported 132.784 tonnes [3].

Pistachio nut *(Pistacia vera L)* is the fruit stone of *Pistacia vera*. Each fruit has a single stone which consists of a kernel covered by a testa and enclosed in a shell. The shell itself is enclosed in a protective hull. One month or more before maturity the shell usually partially splits within the hull [4]. Its high nutritional value and unique flavour as a snack and a food ingredient. It is consumed in confectionery and snack foods. The shell (endocarp) of pistachio nuts split along their sutures which is a desirable trait because pistachio nuts are usually marketed in-shell for eating out of hand as a snack food.

The nutritive composition of raw pistachio and roasted –salted pistachio are shown in Table 2.1. The composition of raw and roasted pistachio, the protein, fat, carbonhydrate and vitamin levels, is almost same. Due to its high nutritional value and split shell, pistachio is an increasingly important nut crop consumed raw, salted or roasted. Pistachio kernels are very popular as a snack, but also are used as an ingredient in meat products like salami or sausages, or in the confectionary industry as a part of chocolate, cakes, Turkish delight, baklava, ice cream and other traditional Turkish sweets.

Raw materials and products were specified for the identification and the assessment of food safety hazards including biological, chemical and physical characteristics. The physical quality characteristics of fresh de-hulled nuts and kernels include their dimensions and weight, percentage of split nuts, and ratio of kernel/nut (w/w) [5]. The drying process impact the moisture content, nut and kernel dimension. Kernel colour is also a characteristic of quality and reflects compositional differences. The physical properties of pistachio nut and its kernel are important to design the equipment for processing, transportation, sorting, separation and storing. Designing such equipment without taking these into consideration may yield poor results. Therefore the determination and consideration of these properties has an important role [6].

Proper harvesting and postharvest handling are key operations in achieving maximum yield of good quality nuts that determine marketability and profit. Processing right after harvest is very important on pistachio quality [7].

Table 2.1. Nutrient compositions of raw and roasted-salted pistachio (value per 100 g) [8]

	Raw	Roasted and Salted
Energy, kcal	562.00	568.00
Protein, g	20.27	21.35
Fat, g	45.39	45.97
Carbohydrate, total, g	27.51	26.78
Ash, g	2.91	3.87
Mineral		
Calcium, mg	105.00	110.00
Phosphorus, mg	490.00	485.00
Magnesium, mg	121.00	120.00
Potassium, mg	1025.00	1042.00
Sodium, mg	1.00	405.00
Iron, mg	3.92	4.20
Zinc, mg	2.20	2.30
Vitamins		
Thiamin, mg	0.87	0.84
Riboflavin, mg	0.16	0.158
Niacin, mg	1.3	1.425
Pantotenic acid, mg	0.52	0.513

2.1.2. Bulgur Characteristic

Bulgur (in general produced from *Triticum durum*) is a very famous industrially processed ancient wheat product around the world [9]. It is widely consumed in Central Asia, the Middle East, North Africa and eastern European.

Main properties of bulgur are having light yellow color, special grinding size and taste. That's why, *Triticum durum* is a main wheat type, which is used at industrial scale. Durum wheat is used because of;

- It is suitable for good milling conditions,
- It has light and good yellow color,
- It has more nitrogenous compunds for making complex of nitrogen and starch to form hard texture,
- It has uniform water absorption capability,
- It gives good texture and chewing characteristics, and
- At the final product (bulgur), there is no disruption and adhesiveness due to its hard strucure and high protein content.

Bulgur production and consumption around the world has increased due to their low cost, long shelf life, ease of preparation, high nutritional value and pre-cooked properties. As a whole grain food, bulgur is popular in the health food sector, and its pleasant flavour lends itself to inclusion in vegetarian meals [10]. Best known as an ingredient in tabouli salad, bulgur is also a tasty, low-fat ingredient in pilaf, soup, bakery goods, stuffing or casseroles. It is an ideal food in a vegetarian diet because of its nutritional value and versatility.

Bulgur is excellent sources of carbonhydrates, protein, fiber, minerals and vitamins without fat or cholesterol. The nutritive composition of wheat and bulgur is shown in Table 2.2. According to Table 2.2, carbonhydrate levels is higher bulgur than of wheat but the protein, fat, ash and fiber levels are almost lower than those of wheat [8].

Cooking and drying steps are the most critical steps in bulgur processing. The cooking process affects the mineral content, and there is a 70 % retention of riboflavin, thiamine and niacin levels. Parboiling process affects the mineral content. Generally, hard wheat are preferred as a raw material for producing bulgur, since the processing of a soft wheat grain will cause a major loss in protein percantage and physical characteristic.

The quality criterion for farmer is productivity and his concept of quality is closely linked to the need to obtain high yield in order to maximize profit. However, the milling industry requires a high extraction rate (i.e. the proportion of wheat kernels that is milled into semolina). The durum wheat processing industry requires seed lots which are homogenous for moisture, test weight and protein content [11]. In addition significant quality criteria for bulgur are cleaning, colour, cooking property, size, shape and taste, which can be measured on the production line. In addition to these significant (important) quality criteria (standart) for bulgur are cleaning, colour, cooking property, size, shape and taste, which can be measured on the production line.

Table 2 .2 Nutrient composition of wheat and bulgur (value per 100 g)[8]

	Wheat(durum)	Bulgur
Energy, kcal	339.00	342.00
Water,g	10.94	9.00
Protein, g	13.68	12.29
Fat, g	2.47	1.33
Carbohydrate, g	71.13	75.87
Fiber, total dietary,g	3.9	18.30
Ash, g	1.78	1.51
Mineral		
Calcium, mg	34.00	35.00
Phosphorus, mg	508.00	300.00
Iron, mg	3.52	2.46
Zinc, mg	4.16	1.93
Vitamins		
Thiamin, mg	0.419	0.232
Riboflavin, mg	0.121	0.115
Niacin, mg	6.738	5.114
Pantotenic acid, mg	0.935	1.045

2.1.3. Red Pepper Characteristic

Pepper is a vegetable of importance in human nutrition. Pepper, specifically *Capsicum annuum*, is a general name for plants coming from *Capsicum species of Solanaceae* family. It is very interesting to know what the contribution of an individual food product is to daily nutritional needs and how maturity affect nutritive composition and so biological properties [12].

The nutritive composition of raw red pepper and dried red pepper is shown in Table 2.3. Chemical composition of pepper fruit fairly well, mainly with respect to vitamin (C, E), b-carotene and carotenoid pigments content. Red pepper (*Capsicum annuum L.*), as other vegetables, is a good source of antioxidant substances such as carotenoids (provitamin A) and vitamin C. It is eaten as a raw and cooked vegetable and also used commonly in making paste, pickle, and sauce. Red ground pepper made by drying and pulverizing of the hot red pepper is used as a spice and flavor ingredient in the food industry. Also, reported that its wide range of medical applications, from increasing appetite, relieving pain associated with arthritis, to diuretic effect [13]. Spices are common food adjucts that impart flavour, aroma and colour to foods. Several common spices are now understood to exert many beneficial physiological effects.

During drying, vegetables undergo physical, structural, chemical, organoleptic and nutritional changes that cause quality degradation. The influence of drying on various quality parameters such as carotenoids and non-enzymatic browning, colour, L-ascorbic acid and sugar retention in green pepper or colour [14]. The red pepper *(Capsicum spp.*) is one of the main sources of carotenoid pigments, some experimental studies on pepper drying were reported in the literature. It is reported that the color of red pepper changed considerably during drying. Hot-air drying produced red pepper with a blackish red color compared to be sun drying method. It is studied that green bell pepper dices dried at different temperatures and relative humidities. Drying rates increased with increasing air temperatures and decreasing relative humidity [13].

Table 2.3 Nutrient compositions of raw and dried red peper (value per 100 g) [8]

	Raw	Dried Red Pepper
Protein	19 gr	12gr
Fat	0,1 gr	17gr
Carbohydrate	4 gr	56.6 gr
Calcium	1 gr	148 mg
Phosphorus	1 gr	293 mg
Iron	2 gr	8 mg
Vitamin B	21 mg	1 mg
Vitamin B2	84 mg	2 mg
Vitamin C	88 mg	76 mg

2.1.4. Aflatoxin

Aflatoxin formations depend on some environmental factors. Therefore, the amount of contamination changes according to geographical dwelling, agricultural and scientific studies, and sensitivity of products to attack of moulds during harvest, storing and/ or processing period. If necessary protective precautions are not taken, aflatoxin can form in fatty- dry fruits with stiff shells (nut, peanut and pistachio), some dry fruits (dried fig, raisins), fatty seeds (cotton seed), some cereals and spices (red-pepper, black pepper, coconut) and additionally in some animal products (milk, cheese, offal). Aflatoxin is toxic metabolits which is produced by *Aspergillus flavus* or *Aspergillus parasiticus* existing in or on the foods and baits.

The first condition for aflatoxin formation in a foodstuff is the infection of spores of the mold which produces this toxin to foodstuff. The second important condition is the foodstuff itself and the ambiance where it is have the conditions enabling these mold spores to multiply by sprouting. 25-30 ^oC temperature and relative humidity over 70 percent (or water activity in foodstuff over 0,70) are needed for the growth of molds producing aflatoxin.

Aflatoxin are produced primarily and mostly by some strains of *Aspergillus flavus*. In addition, all the strains of *Aspergillus parasiticus* produce it. There are mainly four aflatoxin: B1, B2, G1, and G2. B1 and B2, and G1 and G2 have different structures since B1 and B2 give blue fluorescent when exposed to UV, and G1 and G2 give yellow-green fluorescent when exposed to UV. In addition to this, M1 and M2 which are two metabolic products are indications of the fact that foods and baits directly become contaminated. These aflatoxins are isolated from milk of animals living on baits with aflatoxin for the first time and therefore they are symbolized as M. These toxins have very similar structures and are a unique group in a form which is oxygenized in high degree, and they are naturally composed of heterocyclic compounds.

Although molds and spores do not generally have any negative effect on human health, some substances they produce are harmful, and most of these substances do not disappear with high temperature. There is the possibility of formation of aflatoxin or another similar poisonous substance in every foodstuff where molds can grow.
Very small amounts of aflatoxin in foodstuff can bring about this effect which spoils human health. According to the notification about the Ministry of Agriculture the Maximum Limits of Propagators in Foodstuffs in our country, the total Aflatoxin (B1, B2, G1 and G2) is maximum 10 ppb for pistachio, dry fruits and processed foods which have been produced from these and it is maximum 5 ppb for B1. This limit is 2 ppb in European Union countries.

The number of analysis of aflatoxin for pistachio which is from our study subjects is 8472 in last five years according to the data of Gaziantep Commercial Exchange Bureau, and 5.6 percent of these analyses are above the total aflatoxin which is limit applied in Turkey.

2.2. Processing Technologies

2.2.1. Pistachio Processing

Pistachio nut (*Pistacia vera L.*) is one of the popular tree nuts. Pistachio is grown in the Middle East, United States and Mediterranean countries. Several species of the genus Pistachio are referred as pistachio, only the fruits of Pistachio vera are acceptable to consumers as edible nuts in Turkey which is known as Gaziantep pistachio nut. The Turkish Gaziantep pistachio nut tree grows in the South East of Turkey.

Gaziantep pistachio processing consists of following steps; dehulling, cleaning, drying, spliting, salting, roasting, and packaging. It is very difficult to Antep pistachio nuts processing units with classical quality control units. Possible product and cross contaminations arising from physical, chemical and biological hazards can be prevented. Pistachio nuts are among the commodities with the highest risk of *Aspergillus flavus* (AF) contamination due to more frequent growth of *Aspergillus flavus* [15, 16].

The serious problems occurring during post-harvest handling and storage of pistachio nuts are mold spore contamination and aflatoxins production which results in serious health hazards and economical losses. Foreign materials and contaminated nuts in the raw material could be addressed as another problem in pistachio processing. It is still produced using traditional ways. In most cases, it is not produced under hygienic conditions and has lower quality criteria in color, size, shape and taste. Modern pistachio processing lines are slowly replacing these old methods.

When pistachios arrive at the processing plant, procedures are conducted as outlined in Figure 2.1. Proper harvesting and postharvest handling are key operations in achieving maximum yield of good quality nuts that determine marketability and profit [17]. Processing right after harvest is very important on pistachio quality [18].

The first stage involves cleaning; such as foreign materials, damaged and empty nuts, etc. are removed by sieves, washers, and separators.

The second stage involves drying and cooling. Drying an important step in pistachio processing is carried out by sun drying or rotary tray dryers. Previously, most processors used a single stage drying process using air at 140-160°F (60-71 °C) for 10-14 hours, to achieve 4-6 % wet bases moisture. Drying time was controlled by the initial nut moisture and the ambient relative humidity. Drying of pistachios is now generally a two-stage process. It uses less energy and increases the output of the heated air dryer compared with the single stage process. The hulled nuts are first dried to 12- 13 % moisture in a column dryer, originally designed for grain drying, or a continuous belt dryer. This requires about three hours at temperatures near 180 °F (82°C). Drying air temperatures above this level cause shells to split so widely the nut drops out. A rotating drum dryer, at the same temperatures, can also be used for first stage of drying. In the second stage the nuts are transferred to flat bottomed grain bins where they are further dried to 4-6 % moisture with unheated, forced air, or air heated to less than 120 °F (49 °C), Plate 18d. This second stage of drying requires 24-48 hours. The nuts can then be stored in these bins until needed for processing. Smaller operations may use bin dryers for single-stage drying. Eight hours at 140-150 °F (60-66°C) will produce the desired 4-6 % moisture. In smaller operations, sun drying and ambient air drying may be used [19].

3-4 days, with a covering for protection so as to inhibit predation by some animals such as birds are necessary for drying in the sun. What is necessary for drying nuts in store houses with ambient air is three days with adequate ambient temperatures and relative humidity. A 4.5 feet (1.4 meters) nut depth and a flowing of air at a rate 70 fpm into the bins are upper limits for store houses. They should not exceed these rates. Fungal growth during early stages of drying is the main disadvantage of this method.

During the drying process, nuts can undergo undesirable reactions (especially rancidity) which cause degradation of quality, because of the odd colors and flavors formed. The major oxidative reactions in dried foods are due to peroxidation of lipids. Lipid oxidation in foods is associated almost exclusively with unsaturated fatty acids and it is often autocatalytic, with oxidation products themselves catalyzing the reaction so that the rate increases with time. The pistachio is a nut with a high lipid content and very rich in unsaturated fatty acids; this makes pistachio nuts very sensitive product owing to rancidity. The hydrolysis of lipids results in a progressive increase of food acidity, caused by the formation of fatty acids. Therefore, lipid hydrolysis favors lipid oxidation because the fatty acids formed can be substrates of the oxidation reaction [7].

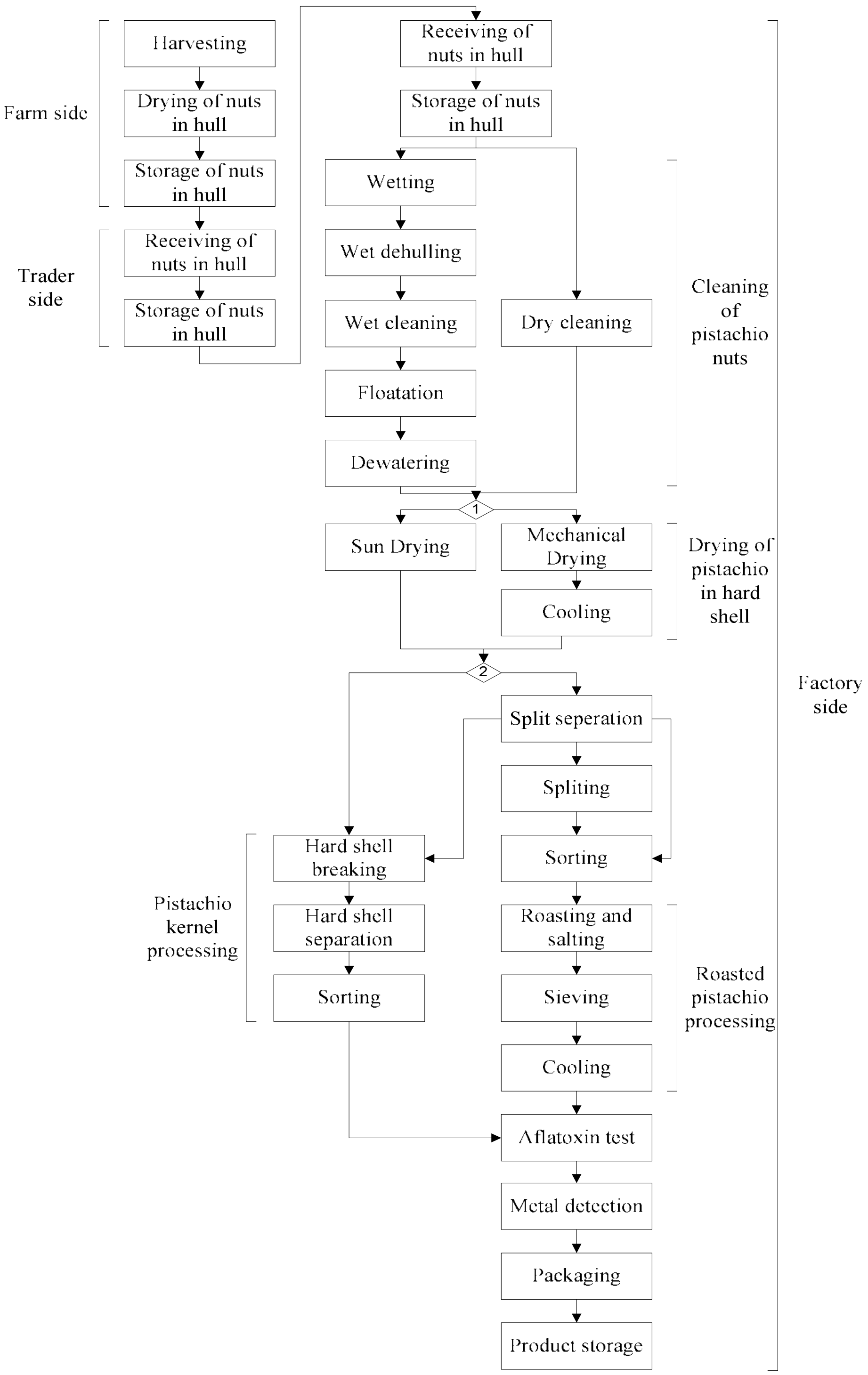
How people make pistachios dried has a huge effect on the quality of products and their costs. Drying at lower temperatures provides good storage stability, but causes longer processing times. Although low water activity undermines or stops the growth of microorganisms, it triggers higher lipid oxidation rates. Furthermore, setting up the most convenient drying conditions so as to prevent damage in pistachio quality is crucial.

The last stage consists of splitting, roasting, salting, and packaging. Young girls separate hard shells of pistachios from pistachios at home or plants in the splitting process. While 15-20 kilos cracking of shells of pistachios can be done in a day per a worker as manual and mechanical in an operation, the cracking capacity of machines is 210-400 kilos in 8 hours. The rate of cracking is higher in pistachios which are elongated and bulky. The 50-70 percent of products collected from pistachio orchards where regular agronomical practices are done is already cracked.

Sizing is recommended before roasting so as to ensure homogeneity in the rates of warmth and salt of fruits. Generally, table salt is added made in the ratio of 1/4 or 1/5 of fruit amount. Roasting process of splitted pistachios is done at 130 ^{o}C and they are salted by 1 percent. Duration of heating, heating temperature and the amount of the added salt is important for product quality and standardization in the roasting process. Cooling is done in some operations after roasting. They are cooled in some operations by being laid to the ground or being superimposed and kept for a night. However, the best cooling method is cooling by being gone through cooling tunnels in a very short while.

Aflatoxin test must be done after cooling process. The serious problems occurring during post-harvest handling and storage of pistachio nuts are mold spore contamination and aflatoxin's production which results in serious health hazards and economical loss. Both total aflatoxin and aflatoksin B1 were detected in 27.3 % (12/40) of unpacked samples with different contamination levels ranging from 0.07 to 7.72 ppb and from 0.06 to 4.08 ppb, respectively. Both of total aflatoxin and aflatoxin B1 were detected in 25.0% (4/16) of packed samples with different contamination levels ranging from 0.07 to 1.41 ppb and from 0.07 to 0.96 ppb, respectively. In addition analysis of 523 pistachio nut samples in Ankara city of Turkey revealed the mean of aflatoxin B1 ranging from 1.0 to 113.0 ppb [16].

What is necessary to inhibit re-wetting and to hold other quality factors is proper packaging. Packing which does not allow air to escape and pass through under vacuum or over nitrogen is preferred. Oxygen and insect control by fumigation which controls atmospheres or lowered temperatures in the storage bins, and insect proof packing affect the pistachio nut quality in storage. The recommended temperatures for pistachios are between 32 and 50 ^{o}F depending on expected storage time; as the temperatures are getting low, the storage life is becoming longer. Flushing with nitrogen to exclude oxygen or vacuum packaging can be used in changing the atmosphere in the last product. Fumigation with phosphine can be used in controlling insects in stored pistachios. In addition to this method, insecticidal controlled ambient or radiation can be used in controlling insects·



1. Decision for drying method; 2. Decision for final product (kernel or snack food)

Figure 2. 1 Flow diagram of pistachio processing in Turkey

2.2.2. Bulgur Processing

Bulgur is a very famous industrially processed ancient wheat product around the world which is generally produced from *Triticum durum*. It can be categorized either as a semi-ready-to-eat food or a ready-to-eat food [20]. Bulgur is the main ingredient used in more than 250 kinds of meals due to its long shelf life, low cost, ease of preparation, high nutritional value, taste and resistance to radiation, insect, mites and microorganisms [21]. Durum wheat (*Triticum durum L.*) is used for the preparation of bulgur, noodles, couscous and various types of bread in the Middle East and North Africa [22].

Bulgur has gained importance as a substitute for rice in the western countries. Due to its physical, nutritional and dietetic properties (i.e. long shelf-life, stopped respiration, inactivated enzymatic and microbial reactions, resistance to absorbance of radiation, prevention of intestinal cancer and attacks by insects, inhibition of phytic acid effects, excessive folic acid and dietary fiber contents etc.), production and consumption of bulgur increases in developed countries [20].

Processing steps during the bulgur production cause the gaining of the some functional characteristics on the finished product as follow [23]: (i) resists mold contamination, (ii) resists insect attacks, (iii) inactivation of enzymes due to the cooking operation, (iv) inactivation of microorganisms due to the cooking and drying (pasteurised), (v) numerous nutritional benefits, original wheat kernel nutrients are encapsulated during the processing, (vi) low fat, high protein, whole grain food, (vii) appealing taste, (viii) easy preparation and semi or ready to eat food, (ix) inexpensive and economical, (x) does not absorb radiation, (xi) long shelflife, starch is gelatinised and the kernel is almost cooked during processing therefore bulgur is more stable than wheat in hot and humid environments, (xii) consumable as individually due to its nutritional properties and it is a good source for folic acid, (xiii) the best processing method to decrease the available phytic acid content in contrast to increasing the bran content (cellulose part, high mineral) [23].

It is basically produced using cooking, drying, dehulling, grinding and classification steps. Bulgur is yet produced using traditional principles. Problems such as labor cost, uncontrollable processing line and lack of automation are main problems faced in Europe when bulgur production started there 2 or 3 years ago. They are important for the bulgur production, and what makes them important is taste, color, cooking property, shape and size which can be measured on the production line and crucial quality criteria for bulgur. Hence, what should be used for bulgur production are standard-processing conditions. The first problem faced in bulgur production can be considered as foreign grain seeds in the raw material. Conventional ways have been still used in bulgur production. The production is usually done under unhygienic conditions, and the size, shape, taste and color of the bulgur are lower in quality. There is a gradual transition from old bulgur processing methods to modern bulgur processing lines. A flow diagram for basic bulgur diagram is Figure 2.2 a flow diagram shown for basic bulgur processing. There are three stages of basic bulgur processing. Pre-cleaning is the first stage. This stage includes removing of foreign materials such as weed seeds, non-grain materials, and damaged and shivered kernels by sieves, washers and separators. Removing of dust and dirty materials is achieved by washing, and excess water is removed by centrifuging. An increase up to 15-17 percent in moisture content of the wheat is possible.

The second stage involves tempering, cooking, and drying. Tempering is the controlled addition of water to the wheat in order to soften the endosperm, facilitate separation of the bran, and toughen the bran. The basic reason for cooking the wheat is to convert the starch into a digestible form by gelatinization. The cooking process varies from using atmospheric cooking (95 °C) in small enterprises to using pressurized cookers in larger facilities. During cooking, temperatures below 95 °C are preferred in order to minimize the loss of nutritional compounds. One of the most important processing steps to control the quality of bulgur is the cooking operation due to deformation or dispersion risk of the wheat kernel [24]. During the cooking operation two parameters are controlled. The first one is the wholeness of the wheat kernel i.e. no deformation, and the second is the complete cooking of the wheat i.e. no opaque white centres the gelatinized endosperm is essentially translucent but the ungelatinized starch appears in the endosperm as central white spots. Deformed wheat cannot be used for bulgur production and can cause a lot of problems for subsequent operations i.e. drying, milling etc. Cooking and drying steps are the most critical stepsin bulgur processing. Cooking time and temperature affect the wheat kernel due to water absorption. The effects of the processing variables and the modelling of the cooking operation are necessary to systematically design the cooker and to understand the effects of cooking on the bulgur production. During the cooking operation, the crease of the wheat kernel opens and the width of the kernel increases. The crease of the wheat kernel can be dispersed due to the excess cooking operation and, gelatinised starch leached out. Disruption of the wheat kernel and the leaching of the starch during the cooking operation, cause a lot of problems (stickiness, size deformation etc.) for the subsequent operations (drying, conveying system, peeling and quality loss of the finished product). Traditionally, the cooking of the wheat to produce the bulgur is controlled using the change of the size of the wheat kernel [23].

There should be no white spots on the cooked wheat and gelatinization of starch has to be completed by the cooking process. The amount of water that is added is important. The moisture content must be grater than 40 %. If the moisture content of the kernel is less than 40 %, white spots appear in the kernel, which are ungelatinized starch. If an insufficient amount of water added is added, complete gelatinization will not be achieved. If too much water is added there will be a loss of nutritional compounds, especially vitamin B, that will occur during decantation of water. Drying an important step in bulgur production is carried out by fluidized bed, rotary dryer, sun drying, tower, and tunnel dryers . Cooked bulgur is usually dried in a tunnel drier with a hot air stream at 60°C until a 10-12 % of moisture content is achieved. Mechanical dryers are different from the conventional sun drying method in that they are more hygienic.

The last stage consists of dehulling, grinding, polishing, and classification. In the dehulling process, bran is removed from the cooked wheat by abrasives or stone mills. The milling operation, one of the most important steps in bulgur production, is different from milling to produce other granular food products such as flour and semolina. In wheat milling to produce semolina and flour the object is to dissociate the bran from the starchy endosperm. Ideally the separation should occur at starchy endosperm–aleurone layer interface, so that the aleurone, with its high as content, is excluded from the semolina or flour. However, the aleurone layer, ontogenetically part of endosperm, is separated as part of the bran fraction during milling together with some underlying starchy endosperm. Also in conventional flour milling there is a gradual size-reduction achieved by a series of rolls with different corrugations and speed ratios. The first-break in the milling process opens up the wheat kernel and releases the endosperm with minimum bran breakage [9]. On the contrary, bulgur is milled from cooked wheat to form pieces with various dimensions which are then classified by size. The wheat kernel is cooked, and after this process it is dried before tempering. In addition, prior to milling the cooked kernel, bran is completely removed.

These operations increase the penetration rate of water into the kernel so that water absorption into the cooked wheat kernel is faster than in tempering uncooked wheat for flour or semolina production. There is no universal milling method or system for producing bulgur. The two most popular, the Antep and Mut (Karaman) systems, are basically different [9]. In both systems, the cooked and dried wheat is tempered up to 15–17 and 20–24 % moisture during 15–20 min and 10–14 h for Antep and Mut (Karaman), respectively. Dehulling and milling of cooked/dried wheat in the Antep system is achieved separately using a vertical emery dehuller and disc or hammer mills, respectively. In the Mut (Karaman) system, dehulling and milling are performed simultaneously using a stone mill. These differences between the two bulgur production systems affect the colour, shape and size of the bulgur particles. Due to the abrasive effect of the stone mill, Mut (Karaman) bulgur has a light yellow colour and an oval shape but the control of process conditions (labour, maintenance, energy consumption and high moisture level) is difficult [9] so that 70 % of the total world's bulgur is produced using the Antep milling system. The grains are than ground to produce small particles; the use of roller milling equipment has become widespread, but color and shape problems sometimes occur. The size and shape of bulgur is always important. Oval and smooth shapes are preferred. Screening and classification are the next steps. Color sorting equipment may be applied. The color of bulgur should be light yellow and homogeneous. The polishing step is not always used since bulgur is nutritionally damaged during polishing when a cylindrical system is used to polish the product to obtain a good yellow color [25].

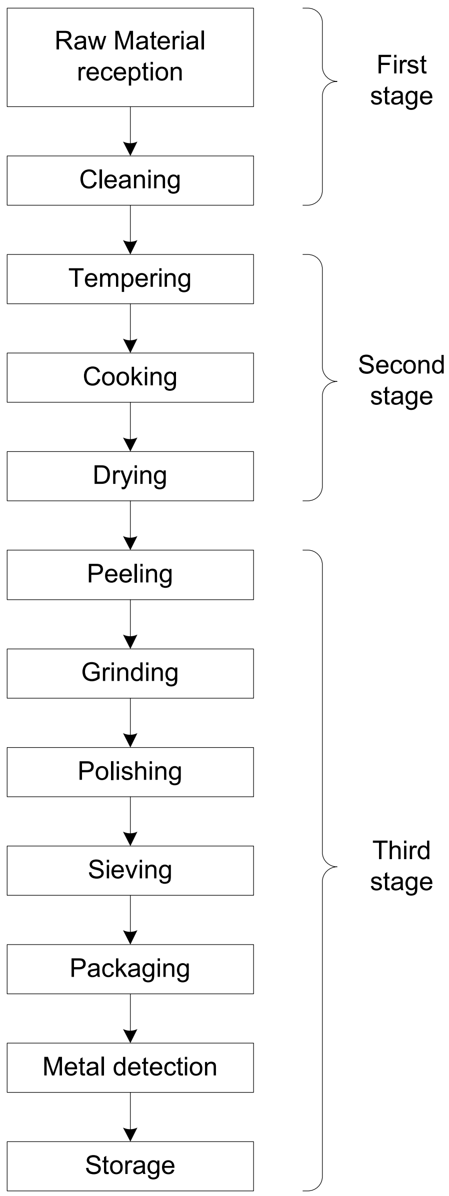


Figure 2. 2 Flow diagram of bulgur processing in Turkey

2.2.3. Red Pepper Processing

Red pepper is one of the main agricultural products in Turkey. Pepper growing for the purpose of drying is common in the Kahramanmaraş region of Turkey [13] . Red pepper is used in foods for its properties as flavoring, seasoning, imparting aroma, colorant or pungent products. Red pepper production consists of harvesting and transporting; washing of the fruit surface; seed removal; drying; milling of pepper to the required size and finally, the storage of product in bags. Grand red pepper (GRP) is sensitive to aflatoxin contamination depending on temperature, humidity, drying and other processing conditions [26]. Ground red pepper made by drying and pulverizing the hot red pepper is used as a spice and flavor ingredient in the food industry. Quality is an important issue in the paprika industry and is an area of conflict between farmers and buyers. Three areas of quality and relevant, colour, pungency and aflatoxin levels. Non-enzymatic browning is another cause of paprika color degradation. Limited reports are available in the literature on browning of paprika during drying and/or storage [27].

Red pepper is a very sensitive product for aflatoxin formation depending on unsuitable processing conditions [28]. The first factor which causes aflatoxin formation in a food product is infection of mold which produces the toxin to the food product. The second factor which is more important is that the product and its environment have the conditions enabling mold to propagate. Molds develop in humid and hot environment. The molds which cause aflatoxin emerge an environment where the temperature is 25-30 ^{o}C and the relative humidity is over 70 percent. It is possible for the molds which can be always found in the air and the soil to inflect with peppers. Yet, it is almost impossible to prevent inflection. Therefore, what is important is to eliminate the conditions which enable the molds which are around to flourish. In this respect, the pepper which has been just harvested creates an ideal environment for propagation of molds and aflatoxin formation because of the temperatures during harvest and its own moisture gradient. The only way of preventing aflatoxin formation is to enable the moisture of the pepper to decrease in such a short time that does not give the mold the chance of growing; in other words enabling the pepper to dry rapidly. Aflatoxin forms in peppers which have been bruised and whose waxy layer on the surface has been damaged. For that reason, plastic baskets are used, as it is applied in many products, so that peppers are not bruised in the course of being carried them to the shelves while harvesting.

Modern pepper processing lines are flow diagram for basic pepper processing is shown in Figure 2.3. The basic system for processing red pepper takes places in three stages. The peppers whose maturity has been monitored at first stage involves pre-cleaning; foreign materials such as damaged and shriveled, spoiled and crushed peppers are removed. The peppers are evacuated to the “delivery canal” and they are carried to the factory, to the washing machine by the water in this canal [29].

The delivery canal is made up of aluminum or painted iron sheet. The delivery canal stretches from the raw material intake platform to the factory with a mild slope, and peppers are carried into the factory through the water given at the beginning of the canal. A nearly prewashing is applied by wetting here. The peppers wetted and pre-washed are washed meticulously before shelling. Modern pepper washing machines are composed of two consecutive washing tanks. Here washed peppers are conveyed to shelling belt by being continuously carried via elevator [29].

Shelling is performed in a rolling belt. On the both side of the belt, generally female workers shell the peppers passing in single file on the belt. Shelling means segregating directly rotten, squashed or green peppers which are not convenient for pepper production, and separating the convenient parts of peppers by cutting the defected parts of the defected peppers. In this respect, in one hand shelling workers distinguish the fruits which are too defected to be cut by knife and cleaned; on the other hand they have to cut some parts of peppers. For that reson, some factories the first two or three workers segregate only the defected ones and the other workers are charged with only cutting the defected parts. So as to be successful, the shelling workers are required to have adequate information on shelling and know pepper defects and illnesses. The processed peppers can bear some defects for various reasons. These defects are blossom-bottom rottenness, root-crown rottenness and anthracnosis, and they should not be processed by any means.

The second stage involves cutting, sun- mechanical drying ,cooling and drying . The disintegration process happens in different ranges depending on drying method. If the peppers are dried with solar energy or in the outdoor, the peppers are broken into 2-4 pieces in sun-drying method. If they are dried in ovens, they are roasted by firstly being broken into 6-8 pieces (strip cutting), and then by being reduced into 1x1 cm by being cut horizontally in so-called cube-cutting (but, it must be square-cut). Breaking the pepper into two or three pieces and then drying by extracting the core slot reduce the drying duration in to which is normally 10-15 days. With this method, the moisture gradient decreases to a level that *Aspergillus flavus* cannot be developed at the end of the first day. Therefore, drying in a such way can dramatically reduce the problem [29].

Drying of red pepper all over the world is carried out by either sunlight or dryers using solar collectors [13]. Traditionally, in Turkey, peppers are dried in the open air and exposed to sunlight, which usually takes 8– 10 days. This practice is a common method, yet it has several drawbacks such as time consuming, prone to contamination with dust, soil, sand particles and insects, and being weather dependent [28]. Pepper cultivar, drying method, and storage period significantly affected the color characteristics of paprika. Traditionally, paprika is obtained by sun drying of red peppers. Sun drying is a lengthy process, taking up to 10 days to bring moisture content to 9.9 % (wet basis). Since paprika is susceptible to fungal proliferation, this process creates favorable conditions for mycotoxins contaminations [27]. To prevent fungal proliferation, different drying methods have been employed in the processing of paprika.

Tunnel drying has become popular for paprika processing mainly due to a relatively short drying time, uniform heating/drying, andmore hygienic characteristics. With a drying temperature of< 50–60 _C, it reduces drying time to less than 20 h; However, what accompanies the tunnel drying is browning reactions and color degradation in paprika [27].

The last stage consists of storage, milling, siewing, and packaging. In the production of paprika, a certain amount of salt can be added in moisturizing, salt and oil (olive oil is recommended) are added to the product in milling process, and an integrity is ensured simultaneously by mixing oil and salt.

The tecnologies used and the properties of the raw material affect the quality of the end product. Technology used in the grand red pepper production is very important for the contamination and growth of molds, and production of aflatoxins. Red pepper is sensitive to aflatoxin contamination depending on relative humidity and temperature in new harvest, drying, storage and other processing conditions. Many survey showed the presence of xerophilic mould species, especially *Aspergillus fumigatus*, A*spergillus flavus, Aspergillus niger, Aspergillus ochraceus*, in most pepper samples [30].

It will hinder these problems to dry the grand red pepper under controlled conditions (temperature and humidity) in a factory. Additionally, there are some other problems in processing for mold contamination and growth, and afloxin formation such as unpacking and storage under unfavorable conditions.

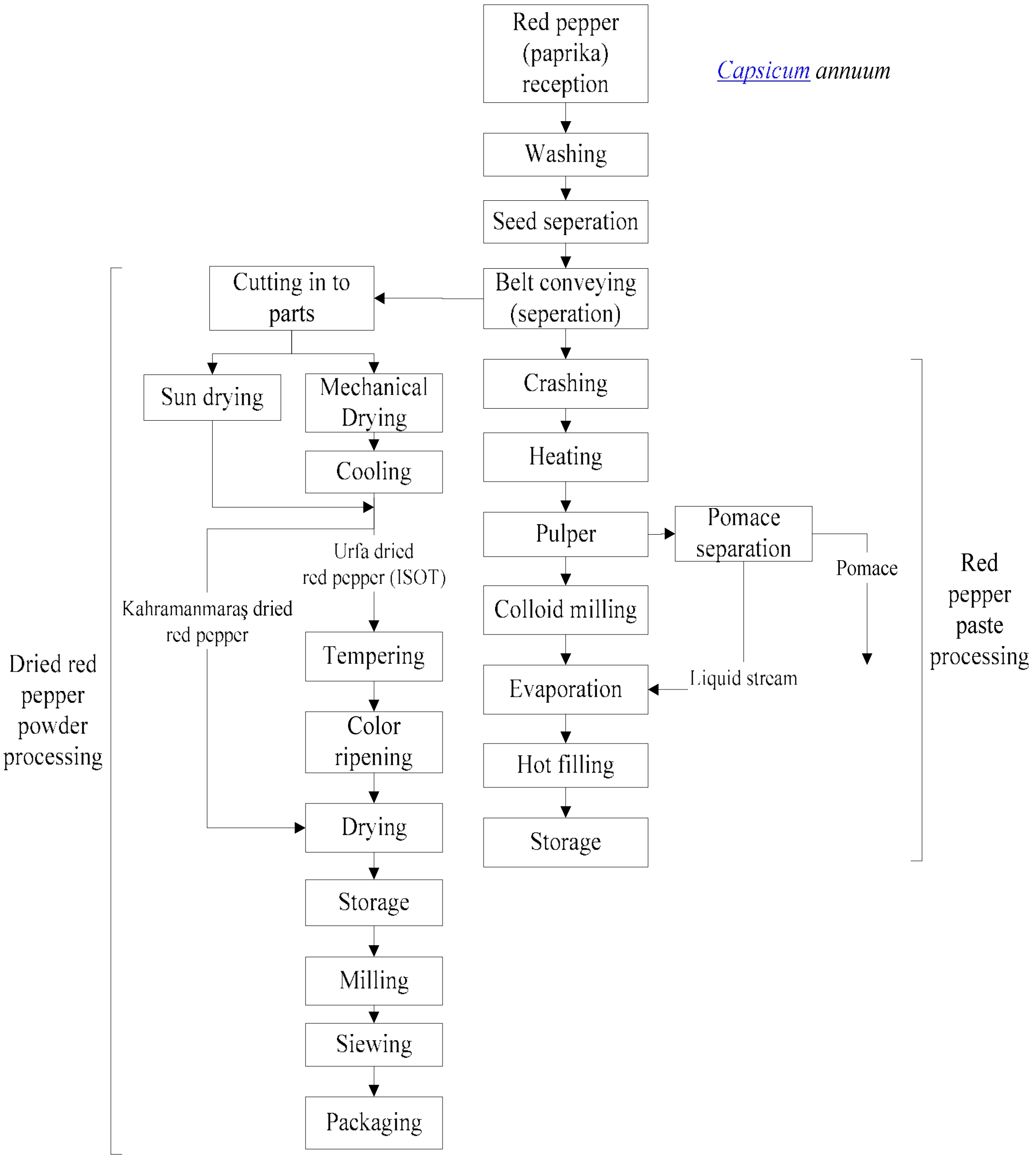


Figure 2.3 Flow diagram of red pepper processing in Turkey

2.3. Food Safety and Quality Systems

Problems connected to administration, supplier, production technologies, working environment, human resources, and control activities affect food safety and quality. These problems influence the whole production process ranging from raw material to finished product. What is necessary to be successful in manufacturing products with desired quality, expected quality and safety assurance is to understand highly important control points, the processing factors and their effects on product quality. No information related to quality and safety has been published so far.

It is necessary to have effective national food control systems to protect the health and safety of domestic customers. They have also critical importance in making it possible for countries to be sure of health and safety of their products while entering international markets and of suitableness of their imported food to national expectations. The new international markets for food trade make it obligatory for trading countries to make stronger their food control systems and to introduce and encourage risk-oriented strategies. This is more important for developing countries than for other countries since they aim at reaching improved food safety, quality and nutrition, yet it is difficult since it requires a high level of political and policy commitment.

When the terms food safety and food quality matters, people can get confused. Food safety is related to all the hazards, chronic or acute, that people may across and that make people injured because of food. It cannot be debated. Quality includes all the features of products that are a determining factor on customer's opinion of the product. This includes not only negative features such as spoilage, discoloration but also positive features such as origin, flavor, and color. The difference between quality and safety is implied by public and it affects the nature and the content of food control system conformed to the society.

Therefore, in addition to training and education, community outreach programs and increasing voluntary compliance, effective enforcement of compulsory requirements should be a part of an ideal food control system. Emergence of preventive approaches such as Hazard Analysis Critical Control Point System (HACCP), has lead the industry to take greater responsibility for and to control of food safety risk. Such an integrated approach make easier to improve consumer protection precipitate agriculture and the food processing industry in an effective way and increases domestic and international food trade.

2.3.1. Pre -requisite Programs

Pre-requisite programmes (PRPs) such as Good Manufacturing Practice (GMP), Good Hygienic Practice (GHP), Good Agricultural Practice (GAP), and Good Storage Practice (GSP) must be working effectively within a commodity system before HACCP is applied. If these pre-requisite programmes are not functioning effectively then the introduction of HACCP will be complicated, resulting in a cumbersome, over-documented system [31].

The organization shall establish, implement and maintain PRP(s) to assist in controlling

a) the likelihood of introducing food safety hazards to the product through the work environment,

b) biological, chemical and physical contamination of the product(s), including cross contamination between products, and

c) food safety hazard levels in the product and product processing environment.

The PRP(s) shall

a) be appropriate to the organizational needs with regard to food safety,

b) be appropriate to the size and type of the operation and the nature of the products being manufactured and/or handled,

c) be implemented across the entire production system, either as programmes applicable in general or as programmes applicable to a particular product or operational line, and

d) be approved by the food safety team.

The organization shall consider the following when establishing these programmes:

2.3.1.1. Buildings and auxiliary facilities associated structures, settlements

The design of the buildings and the facilities ;

- should ease the cleaning
- should not give access to pests to live and take refuse, and
- should prevent the environmental pollutants to occur.

The construction and the maintenance of the buildings should be well and the building must not be a threat in terms of chemical, microbiological or physical food. The aim in the design of the building must be supply the required conditions like cleaning and sanitation, decreasing the pollution caused by foreign bodies, making the pests inaccessible, providing the adequate application of all operations. Any program that has been approved and the construction and development shall match each other.

In the process of deciding where the food establishments will be settled, the possible reasons of pollution should be taken into consideration, besides the efficiency of any rational measures which might be used in order to preserve food. When these protective measures are taken into account, the places where the threat for food preservation and appropriateness will be obvious should not be chosen for the establishments. Especially, normally unsuitable places for the establishments are,

- areas and industrial activities that are polluted environmentally threatening the sterilization of food,
- areas exposed to flooding without adequate safeguards,
- areas inclined to pest incursion, and
- areas where either solid or liquid wastes are hard to take off adequately.

The materials of floors, walls and ceilings, and the various coatings and sealants jointing shall cooperate with regulatory requirements and / or normative force. The materials of floors and ceilings should be unbreakable, smooth and easily cleanable, and more suitable for production activities taking place in the area. The color of the walls should be light and mixed well. There must be a sufficient slope in the floors in order for the liquid to drain in the removal process. Well-fitted grids and the windows shall fit each other. The protection of the glass and the direct accession of the production room must be provided.

The area of the door should be clean, smooth, non-absorbent and well arranged. In order to prevent the pollution of food and packaging materials, the location and the construction of the stairs, elevators and other structures must be provided. Suspended structures must be designed and installed so as to prevent the pollution of food and packaging materials and to avoid intervening in cleaning.

The facilities where waste and inedible materials can be stored until their removal must be provided by the institution. The design of these facilities must prevent pollution. The material of the pipes should be smooth and unable to be penetrated and the capacity of the pipes should be sufficient enough to drain all waste without risk of spillage and obstruction. The toilet drain is not through work areas. The design of the containers used for waste must be clear and the type of the container must be waterproof.

There should be the supply of sufficient drainage and waste disposal systems and facilities.The design and the construction of them should prevent the risk of polluting the food and water supply that is safe to drink [15].

2.3.1.2. Included in the study area and social area, the layout of buildings and extensions

Design and Layout: Good food hygiene practices, including protection against cross contamination between and during the operations by foodstuff should be permitted by the internal design and layout of food establishments, where suitable.

The whole building's lighting must be sufficient. The color of foods is not changed by the lighting for the transaction purposes. The protection and the security of the light bulbs and lighting fixtures hanging over the food and packaging materials must be provided in order to prevent food contamination in the case of their breaking.

In order to provide the accumulation of the heat, steam and condensation and the evacuation of the air, the ventilation of the building must be provided. Air intakes should be tightly fitted with screens and an unchangeable material should protect them. The location of the air intakes should prevent them to suck the stale air. The draft should never go to a contaminated area to a clean area.

The availability of a sufficient supply of drinkable water with suitable storage, distribution and temperature control facilities should be provided whenever the insurance of the safety and appropriateness of food is necessary. Drinkable water should conform to the standards in the latest edition of World Health Organization (WHO) Guidelines for Drinking Water Quality, or should be a higher standard of water. Undrinkable water (for the purposes like fire control, steam production, refrigeration, and other similar purposes where there would not be the possibility of food contamination) shall have a distinct system. The connection or the allowance reflux between drinkable and non-drinkable water systems should be prevented.

Personel hygiene facilities and toilets: Personnel hygiene facilities should be appropriate to make sure that an appropriate degree of personal hygiene can be provided and to abstain from contaminating food.

Where appropriate, facilities should include:

- Enough ways of hygienically washing and drying hands, including wash basins and a supply of hot and cold (or suitably temperature controlled) water,
- Lavatories of appropriate hygienic design, and
- Enough shifting facilities for personnel.

Such facilities should be suitably located and designated.

It is possible to wash hands with a sufficient number of sinks with drains to siphon conveyed to the. Facilities for washing hands must be able to distribute the hot and cold potable water, liquid soap, hand towels or sanitary hand dryer and, if necessary, there must be a dustbin to clean. What processing zones must have is a sufficient number of facilities for washing hands, with pipes to siphon connected to the sewer. In areas of transformation, installing sinks whose facets are activated by a mechanism which is not manual. Sanitary facilities are required (e.g. Basins antiseptic for cleaning hands) in areas where there is a food sensitive to microbiological contamination and employees have direct contact with. There must be notices reminding employees to wash their hands. There must be a concord between the drainage and sewage and anti-reflux siphons. Other conduits of the property to a location outside of it must be distinguished from canalizations, the toilets and urinals.

Storage : The places where essential, adequate facilities for the storage of food, ingredients and non-food chemicals (e.g. cleaning materials, lubricants, fuels) should be provided.

Where appropriate, food storage facilities should be designed and constructed to:

- Allow adequate maintenance and cleaning,
- Drain pest access and harborage,

- Make it possible for food to be effectively protected from contamination during storage, and
- Where necessary, find an ambient which can reduce the deterioration of food (e.g. by temperature and humidity control) as much as possible.

Needed type of storage facilities will depend on the nature of the food. If necessary, distinguished, safe storage facilities for cleaning materials and hazardous substances should be provided [15].

2.3.1.3. Water, air, energy and other additional requirements to ensure

The plan for monitoring the water quality of the institution to evaluate the microbiological quality, chemical and physical water from various points of use, including water used to produce steam or ice, and its compliance to standards for drinking water. The program is in need of specifying the frequency of analysis, analytical methods, the name of the person responsible and the records that must be met.

Some procedures are required to be followed by the institution in case that the water does not meet the standards. What we must do is to keep and file records of drinking water (results of laboratory tests) and treatments.

Water Supply: The hot and cold potable water must be used in areas of processing, handling, packaging and storage of food. There must be an adequate flow of temperature, pressure and water for all needs and cleaning operations. When necessary, what institutions must have are storage facilities and water supply systems which provide protection against contamination.

Water must be bacteriological twice a year in the case of municipal water and every month in the case of water from other sources. If the water is chlorinated on site, what the institution must do is to apply two basic controls: a metering device that adds the needed concentration of chlorine and is designed to indicate any malfunction, a justification of the content total chlorine twice a day or an automatic analyzer equipped with a recorder and an alarm. The drinking water and unsafe water should not be mixed. You must not use water that cannot be drunk in areas of processing, handling, packaging or storage of food. There must be a concord between all pipes, valves, connections or other potential sources of contamination and anti-refoulement.

Temperature control: What must be available for heating, cooling, cooking, refrigerating and freezing food to store refrigerated or frozen foods, monitoring food temperatures, and when necessary, controlling ambient temperatures to ascertain the safety and suitability of food are adequate facilities depending on the nature of the food operations undertaken.

Air quality and ventilation: Adequate ways of natural or mechanical ventilation is necessary to:

- Minimize air-stemmed contamination of food, for example, from aerosols and condensation droplets,
- Control the temperatures of environment,
- Control scents which have the possibility of affecting the suitability of food,
- Control moisture, where necessary, to ensure the safety and suitability of food.

Ventilation systems should be designed and constructed in a such way that air does not flow from contaminated areas to clean areas and, where necessary, they can be adequately maintained and cleaned [15].

2.3.1.4. Support services, including waste and sewerage systems

Waste materials are manufactured as a by-product of food processing and preparation. It must be possible for people to identify containers for waste, by-products and inedible or dangerous substances, and these containers should be suitably constructed and, where appropriate, made of water-proof material. Containers where dangerous substances are kept should be identified and, where appropriate, be lockable to inhibit malicious or accidental contamination of food.

2.3.1.5. Compliance with the cleanliness of equipment, maintenance and preventive maintenance for the correct positioning

General design and installation of the equipment: In order to prevent conditions that have the likelihood of causing food contamination, what institutions must do is to use equipment designed for the production of food and install and maintain it.
Equipment should be located so as to:

- Permit adequate maintenance and cleaning,
- Function in way that suits its intended use, and
- Ease good hygiene practices, including monitoring.

Equipment and containers (other than once-only use containers and packaging) which can have contact with food, should be designed and set up to be sure of that, where necessary, people can adequately clean, disinfect and maintain to hinder the pollution of food. Equipment and containers should be constructed by materials with no toxic effect in intended use. If necessary, people can move them or they must be durable and capable of being separated to allow for maintenance, cleaning, disinfection, monitoring and, for example, to facilitate inspection for pests.

The design and maintenance of equipment and utensils must be in a way that prevents pollution of food. The equipment and utensils should be made up of materials resistant to corrosion. Food surfaces must be non-absorbent, non-toxic, smooth, without chipping and unchangeable by food and be able to cope with cleaning and sanitation repeated. All chemicals, lubricants, paints and coatings used on food surfaces must suit to regulatory requirements and/or normative force. The installation of the equipment and utensils must be in a way that prevents pollution of food. A sufficient space in and around the equipment is required.

People charged with cleaning, sanitation, maintenance and inspection must have easy access to equipment. If necessary, equipment must be equipped with an exhaust satisfactory. A clean and sanitary equipment suiting to the sanitation program is needed. The equipment and utensils for materials that cannot be eaten and for that can be eaten must be different. Clearly marked and sealed containers are necessary for inedible material and waste [15].

Calibration and preventive maintain of equipment: Schools must have a list of all control devices and any equipment having probability of affecting food safety, and indicating what they serve. What must be done is to establish protocols and methods of calibration for his equipment and control devices. Thermometers, ph meters, aw-meters, orders of refrigeration units, scales, thermographs, hygrographes, for example, can be involved in this list.

What establishments must show are the frequency of calibration, responsible person, the procedures for monitoring and verification, corrective action and records to keep. Once reagents are used for control or audit the procedures used for their conservation, the documentation of their preparation and verification is obligatory. What are required in the process of the preparation and verification are reagents frequency analysis of all reagents, the name of the person responsible, the timing, conditions of storage and records to keep.

What schools must do is to develop a written program of preventive maintenance giving a list of equipment and utensils, and indicating preventative maintenance to which they are exposed to. It is crucial for the program to specify the nature and frequency of maintenance required by the equipment, including replacement parts, the name of the person responsible, the method of monitoring, verification activities and records to keep [15].

2.3.1.6. Purchase of materials, as required, the product of the control management

Ingredients and packaging materials: Ingredients that need refrigeration where they can be stored at a temperature of 4 ° C or less are exposed to appropriate supervision. The temperatures that frozen ingredients are stored are safe to melt. The refrigerator should be provided with means of verification (thermometer, thermograph, ... etc.).
It is necessary to handle and store ingredients and packaging materials so as not to cause damage and contamination. In order to hinder deterioration and waste, the stock rotation of ingredients and packaging material is controlled wherever is suitable. Packaging materials and ingredients which are susceptible to moisture are stored under conditions where deterioration can be prevented.

What is necessary for receipt and storage of chemical is a dry and well-ventilated area. Places designed in a way posing no risk of cross pollution of food or food surfaces are areas where non-food chemicals are stored. When they are used constantly in the handling of food required, the aim of storing of these chemicals is to hinder pollution of food, their surfaces and packing materials. The chemicals are mixed and stored in clean containers and properly labeled. To distribute and handle these chemical, a person must be authorized and have received appropriate training. All non-food chemicals must conform to regulatory requirements and/or normative force.

***Storage of final products*:** The conditions under which final products are stored and handled are able to prevent deterioration. The stock rotation is controlled so as not to give harms that may pose health risks. Final products returned or suspected non-compliant are clearly identified and are stored in a separate area until they are available as appropriate. Finished products are stored and handled so that the necessary checks can be done and one prevents damage, for example, controlling the stacking height and damage caused by forklifts [15].

2.3.1.7. Prevention from cross contamination

The movement of employees and equipment should be in a way that hinders contamination between products. The organization of products (physical or operational) is important so as to prevent contamination of foods. Institutions must be sure of the physical and operational separation of conflicting activities. Plants have enough capacity for maximum achievable. The place where animals are kept should be completely separated areas for handling and storage of food or packaging materials, and should not give access directly [15].

2.3.1.8. Cleaning and sanitation

Cleaning food, utensils and equipment require appropriately-designed adequate facilities. Adequate supply of hot and cold potable water is necessary for these facilities. Cleaners must be prepared specifically for carrying out certain jobs such as for washing floors and walls, use in a high-pressure washer, cleaning-in-place (CIP), and other purposes. Good cleaners must be economical, non-corrosive, and non-caking and must leave no toxin and no dust. They must be easy to measure or meter, stable during storage, and easily and completely dissolved. Cleaning compound requirement differs in the area and equipment to be cleaned. The selection of compounds for blending, to form a satisfactory cleaner, requires specialized and technical knowledge. What must be taken into account in cleaning compound selection mostly are the nature of the soil tobe cleaned, water characteristics, application method, and area and kind of equipment to be cleaned.

2.3.1.9. Pest control

The purpose of discussing pest control is to acquaint readerswith the major pests that can contaminate the food supply and how the presence of these unwanted guests can be controlled. The food sanitarian has to contend with relatively few species of insects, rodents, and birds, but those encountered can cost the food industry billions of dollars every year. [32] During the past century, an estimated 10 million people diedfrom rodent-borne diseases [33]. An effective program against pests begins with a basic understanding of the characteristics of pest contamination sources and acomprehensive knowledge of safe and effective extermination and control procedures. If a pest control operator is not used to control pests, one or more employees (depending onthe size of the organization) should be trained and made responsible for maintaining effective pest control. The following precautions, suggested by the National Restaurant Association Education Foundation should be considered when applying pesticides:

1. Pesticide containers should be properly identified and labeled.
2. Exterminators employed should have insurance on their work to protect the establishment, employees, and customers.
3. Instructions should be followed when using pesticides. These chemicals should be used for only the designated purposes. An insecticide effective against one type of insect may not destroy other pests.
4. The weakest poison that will destroy the pests should be used with the recommended concentration [34].

2.3.1.10. Personnel / Personal hygiene

Food handlers can transmit bacteria causing illness. In fact, humans are the major source of food contamination. Their hands, breath, hair, and perspiration contaminate food, as can their unguarded coughs and sneezes, which can transmit microorganisms capable of causing illness. Transfer of human and animal excreta by workers is a potential source of pathogenic microorganisms that can invade the food supply. By necessity, the food industry is focusing more on employee education and training and emphasizing that supervisors and workers be familiar with the principles of food protection. These practices should be conducted to ensure personal hygiene:

1. Physical health should be maintained and protected through practice of proper nutrition and physical cleanliness.
2. Illness should be reported to the employer before working with food so that work adjustments can be made to protect food from the employee's illness or disease.
3. Hygienic work habits should be developed to eliminate potential food contamination.
4. During the work shift, hands should be washed after using the toilet; handling garbage or other soiled materials; handling uncooked muscle foods, egg products, or dairy products; handling money; smoking; coughing; or sneezing.
5. Personal cleanliness should be maintained by daily bathing and use of deodorants, washing hair at least twice a week, cleaning fingernails daily, using a hat or hair net while handling food, and wearing clean under clothing and uniforms.
6. Employee hands should not touch foodservice equipment and utensils. Disposable gloves should be used when contact is necessary.
7. Rules such as "no smoking" should be followed, and other precautions related to potential contamination should be taken Employers should emphasize hygienic practices of employees [15].

2.3.1.11. Tracebility

The program written recall procedures must indicate that the company would implement in the event of a recall. The purpose of recall procedures is to ensure that food could be recalled from the market more efficiently, quickly and completely as possible and they should be implemented at any time. The effectiveness of the program should be periodically verified with testing.

Any manufacturer of food must have in place a system which allows complete and rapid recall of any batch of food. Written procedures for recall must include the following:

1. Documents relating to the coding system of products. A product should be identified with the production date code or lot identification. A good coding of products to be used and explained in the written program reminders to allow unequivocal identification of the products to recall and to facilitate an effective recall.
2. Institutions must keep records of the distribution of finished products for a period exceeding the shelf life of products and at least as long as the period specified in the manual inspection or regulations for the products in question. The records must be designed and maintained satisfactorily so that they can easily locate the products to recall.
3. Institutions must keep records of complaints relating to hygiene and sanitation. They must keep records and file reports of all complaints relating to hygiene and safety and measures taken.
4. Institutions must list the team members recall, with their phone numbers at work and at home. An alternate must be designated for each member in case of absence. The role and responsibilities of each team member must be clearly defined.
5. The program must describe, step by step procedures to follow in the event of a recall. These procedures should include guidance on the scope of the recall (at the level of consumption, retail or wholesale), according to the category of the recall.
6. The program must define the means that will be implemented to notify the affected consumers, depending on the type of risk presented by the product recall. It must define the means of communication (fax, telephone, radio, letter, etc..) That will be used to search and retrieve all the products recalled. The program must also include a model of the messages that are sent to retailers, wholesalers or consumers, depending on the seriousness of the risks posed by recalled products.
7. Institutions must provide for control of recalled products, including products and returned products still in stock. It must describe the measures to control

and for which the recalled products, depending on the type of hazard they pose.

8. The program must include the means that will be implemented to assess progress and effectiveness of the recall. Must define how it will be verified the effectiveness of the recall.

Any manufacturer who launched the recall of a food product must immediately notify the appropriate regulatory agency and provide the following information;

- the reason for the recall,
- all the details about the recalled product name, code number or batch number of the establishment, date of production, date of import or export, if any, etc..,
- the quantities covered by the recall, broken down as follows;
  - total amount that the company originally had in his possession;
  - total amount distributed before the recall,
  - total amount remaining in the possession of the company,
- the territory of distribution of recalled product, by region, city and province, and country in the case of an exported product, and the names and addresses of retailers and wholesalers, and
- information on any product that may present the same risks [15].

2.3.2. Hazard Analysis and Critical Control Points (HACCP)

So as to assure the safety of astronauts' food, HACCP was developed as a microbiological safety system at the very beginning of the US space exploration programs. Till that time most food safety systems were based on final product testing and could not fully guarantee safe products since complete testing was impossible. A pro-active, process-oriented system was needed and the HACCP concept appeared [31].

HACCP is a system that identifies, evaluates and controls hazards which are important for food safety. It is a well-constructed, systematic approach for the control of food safety throughout the product system, from the farm to fork. At the same time, it is a management system which assures continuity and puts physical, chemical and biological hazards from raw material to consuming final product under control throughout all the phases of buying, production and distribution of food safety.

You should have a good understanding of cause-effect relationship to be pro-active and it is a crucial element in Total Quality Management (TQM). HACCP is the basis for foundations of well-established quality management systems such as GMP, GHP, GAP, and GSP.

Being based upon on systematic identification and evaluation of damages in foods and ways to control them, Hazard Analysis and Critical Control Point (HACCP) is a food safety management system. It is an crucial component of an integrated approach to food safety. The inter-relationship of HACCP with other food safety tools is illustrated in Figure 2.4.

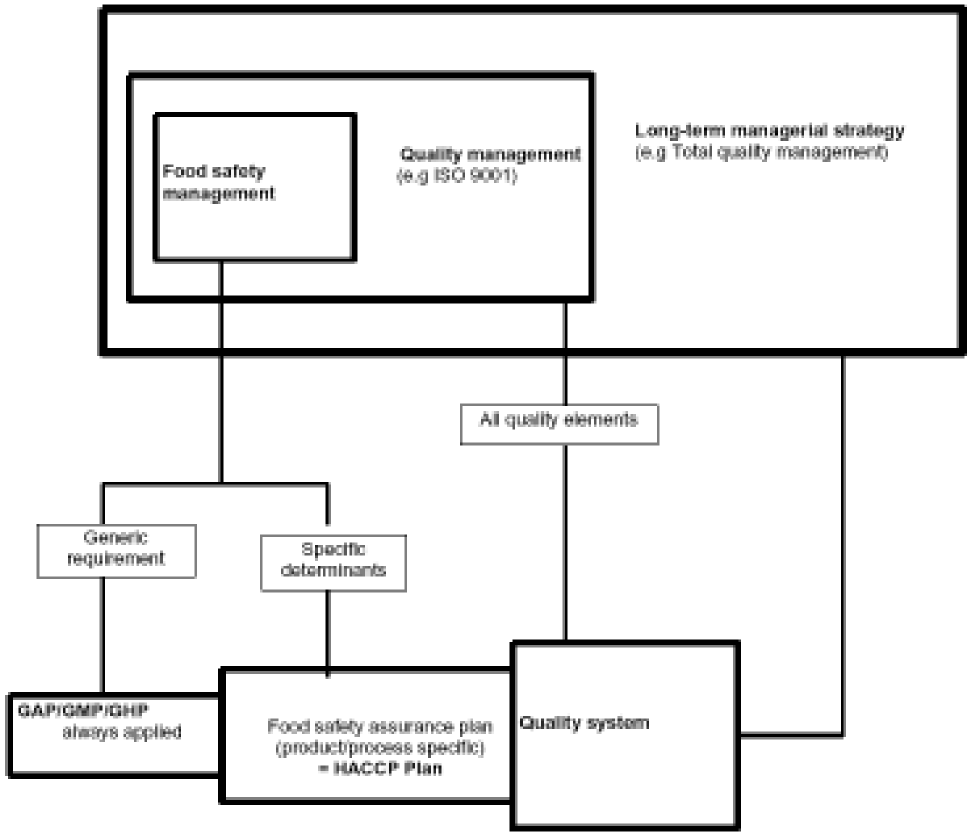


Figure 2.4 Food safety tools: an integrated approach

2.3.2.1. Preliminary Work of HACCP System

i. Establishment of a HACCP team

What is important in exactly understanding the commodity system and being able to identify all likely hazards and CCP is that people from a wide range of disciplines constitute of the HACCP team. The team includes,

- A team leader who is acquainted with the technique and a good listener let all the group member contribute, holds meetings with the group and directs the work of the team to guarantee that the concept is properly applied.
- HACCP team needs a specialist with a detailed knowledge of the commodity system. This specialist is very effective in the production of the commodity flow diagrams.
- Also, the team needs several specialists, each with an understanding of particular hazards and associated risks, e.g. a microbiologist, a chemist, a mycotoxicologist, a toxicologist, a quality control manager, a process engineer.
- It is possible to bring People, such as packaging specialists, raw material buyers, distribution staff or production staff, farmers, brokers, who are involved with the process, and have working knowledge of it into the team so as to provide relevant expertise.
- A technical secretary is necessary to record team’s progress and results of the analysis. If any changes are made to composition or operational procedures, it will be necessary to reassess the HACCP plan in the light of the changes.

The first job that the HACCP team does is to identify the scope of the study. For example, will the whole commodity system be covered or only selected components. This will make the task more manageable and specialists can be added to the team when they are required.

ii. Description of the product

To begin a hazard analysis, a full description of the product, which includes customer specification, is prepared by using a form. This contains information regarding safety, e.g. mycotoxin regulation/target level, composition, physical/chemical properties of the raw materials and the final product, the amount of water available for microbial growth (aw), the amount of acid or alkali in the product (ph,etc.). Also information related to the ways of packing, storing and transporting of product are take into consideration with the facts regarding its’ shelf life and recommended storage temperatures. In which appropriate, labeling information and an example of the label are included. This information will be useful for the HACCP team to identify ‘real’ hazards concerned with the process.

iii. Identification of the product’s intended use

The ways of product’s being used by customers is an important point. Information on how to use products, e.g. by consuming directly, by cooking directly or by further processing, finds a place in the hazard analysis. The nature of the target group for the product may also be relevant, especially if it contains susceptible groups such as infants, the elderly, and the malnourished.

iv. Drawing up the commodity flow diagram

What the team should do firstly is to draw up a detailed commodity flow diagram (CFD) of the commodity system, or that part of it which is related to. The importance of the expertise of the commodity specialist reveals at this stage. Commodity systems will varies in detail around the world, and even within one country there may be a number of variants. Secondary processing will be required to be elaborated for each factory, using generic flows only as a guide.

v. On site confirmation of flow diagram

When they completed the CFD, members of the team visit the commodity system (e.g. farm,store or manufacturing area) so as to make a comparison between the information present on the CFD with what actually happens in practice. This is called “walking the line”, a step by step practice used to check that all information related to materials, practices, controls etc. have been considered by the team during the preparation of the CFD. Information such as time of harvest, drying procedures, storage conditions, the marketing chain, socio-economic factors, grading systems and any incentive for improved quality or safety, and processing systems are collected and included in the CFD as appropriate. The site for which the HACCP plan is being designed is visited as many times as possible to ensure that all relevant information has been collected.

2.3.2.2. Principles of HACCP System

i. Identification and analysis of hazard(s) (Principle 1)

Effective hazard identification and hazard analysis are important to a successful HACCP Plan. All real or potential hazards that have the possibility of occurrence in each ingredient and at each stage of the commodity system are taken into account. There are three types of food safety hazards for HACCP programs:

- Biological: typically foodborne bacterial pathogens such as *Salmonella, Listeria* and *Escherichia coli,* also viruses, algae, parasites and fungi.
- Chemical: Chemical toxins found in foods are divided into three categories: naturally occurring chemicals, e.g. cyanides in some root crops, and allergenic compounds in peanuts; toxins produced by micro-organisms, e.g. mycotoxins, and algal toxins; and chemicals added to the commodity by man to control an identified problem, e.g. fungicides or insecticides.
- Physical: pollutants such as broken glass, metal fragments, insects or stones

The likelihood that a hazard will occur is defined as a risk. The risk may varies in a value from zero to one depending on the degree of certainty that the hazard will be absent or that it will be present. After hazard identification, what should be done is conduction of a hazard analysis in order to understand the relative health risk to man or animal posed by the hazard. Thus, it would be possible to organize and analyze the available scientific information on the nature and size of the health risk regarding the hazard. The evaluation of risk may be subjective and simply is categorized as low, medium, or high. Only hazards which evaluated as an unacceptable risk of being present are taken forward, Principle 2.

After identification of a hazard, appropriate control measures are thought about. They are any action or activity that is possible to be used to control he identified hazard, such that it is prevented, eliminated, or reduced to an acceptable level. The control measure may also contain training of personnel for a particular operation which is comprised GAP, GMP, and GHP.

ii. Determination of critical control points (CCPs) (Principle 2)

Each step in the commodity flow diagram, within the scope of the HACCP study, happen and follow each other and the relevance among each identified hazard is considered. Remembering the stated scope of the HACCP analysis at this stage is also crucial. The team tries to decide on whether the hazard has the possibility of occurrence at this step, and if so whether there are any control measures. If they are able to control the hazard, and it is not best controlled at another step, and it is essential for food safety, then the step CCP for the specified hazard matter. Decision trees are used to determine CCPs, and there is an example of the Codex decision tree in Figure 3.3. However, what are the most important factors in establishing CCPs are HACCP team's judgment, expertise and knowledge of the process. In case of emergence of a step where there is a food safety hazard, but at which there is no adequate control measures, the product is considered as unsafe for human consumption. Production is paused until control measures are available and a CCP can be introduced.

iii. Establishment of critical limits for each CCP (Principle 3)

There are specified and validated critical limits for each CCP. Measurements of temperature, time, moisture level, pH, water activity, and sensory parameters such as visual appearance are involved in criteria which are often used. When there are mycotoxins, critical limits may include the moisture content or the temperature of the commodity. The documentation of all critical limits and the associated permissible tolerances are done in the HACCP Plan Worksheet, and they are involved as specifications in operating procedures and work instructions.

iv. Establishment of a monitoring procedure (Principle 4)

The confirmation of the fact that critical limits at each CCP are being met is done thanks to a mechanism called monitoring. Sensitive methods are chosen for monitoring and these methods produce an immediate result that expert operatives are capable of detecting any loss of control of the step. Corrective actions taken as quickly as possible so as to prevent or minimize the loss of product are obligatory. Monitoring can be done by observation or by measurement, on samples along with a statistically based sampling plan. Monitoring based on visual observation is simple but gives rapid results, and can therefore be acted upon quickly. Time, temperature and moisture content are the most common measurements that are taken.

v. Establishment of corrective action (Principle 5)

When there is an indication of that critical limits are not being met, this means that the process is out of control and corrective action is taken immediately. The corrective action takes the worst case scenario into consideration, but is also based on the evaluation of hazards, risk and severity, and on the last use of the product. Operatives which are responsible for monitoring CCPs are acquainted with and have received comprehensive training in ways of affecting a corrective action. Corrective actions ascertain that the CCP has been put under control. The appropriate disposition of any affected commodity or product is also involved in this action. Whenever possible an alarm system is introduced which will activate when monitoring indicates that the critical limit is being approached, corrective action can be applied to pre-empt a deviation and prevent the need for any product disposition.

vi. Verification of the HACCP plan (Principle 6)

When the HACCP plan has been drawn up, and all of the CCPs have been validated, then it is time to justify the complete plan. Once the HACCP plan is in regular monotonous operation, it is verified and reviewed at regular intervals. This task is the person's who is responsible for that particular component of the commodity system. The appropriateness of CCPs and control measures can thus be determined, and the extent and effectiveness of monitoring can be verified. The confirmation of that the plan is in control and the product is meeting customer specifications is done through microbiological and/ or alternative chemical tests. A formal internal auditing plan of the system will also show a continuing commitment to keep the HACCP plan updated, in addition to representing an essential verification activity.
The ways in which the system can be verified:

- collecting samples for analysis by a method different from the monitoring procedure,
- asking questions of staff , especially CCP monitors,
- observing operations at CCPs, and

- formal audit by independent person.

It would be wiser to remember that that the HACCP system is set up for a particular formulation product handled and processed in a given way.

vii. Recording (Principle 7)

One of the important parts of HACCP process is record keeping. It shows that the correct procedures have been followed from the start to the end of the process, offering product traceability. What it provides is a record of compliance with the critical limits set, and it can be used to identify problem areas. Moreover, the documentation can be used by a company as evidence of 'Due Diligence Defence' as required, for instance, by the Food Safety Act 1990 (HMSO), in the UK. All processes and procedures linked to GMP, GHP, CCP monitoring, deviations, and corrective actions are parts of records that are kept.

Recordings of the original HACCP study, e.g. hazard identification and selection are involved in documentation, but the bulk of it will be records connected to the monitoring of CCPs and corrective actions taken. Record keeping can be performed in many of ways, from simple check-lists to records and control charts. Manual and computer records are equally acceptable, but an appropriate documentation method for the size and nature of the enterprise is designed.

2.3.3. ISO 22000 Food Safety Management System

The standard of food safety management system was published in April 2005 as a standard which could be applied to all the direct and indirect operators which ranges from to food manufacturers to wholesalers and retailer, from package and production materials producers to transportation and cleaning services taking part in the food chain. The standard covers lots of things such as tracking of damaging factor and cleaning and disinfection procedures, and obligatory applications such as GMP (Good Manufacturing Practices) in addition to management system, process controlling, HACCP principals which provide safety in food supply chain and establish a communication with all the related parts. Integration of the standard with ISO 9000: 2000 the quality management system is provided by the fundamental structure components. There is a strong unity among these components as it can be seen in the Figure 2.5. Faced problems such as selecting standard in the previous HACCP documentation process, differences in applications and uncertainties in pre-requirement programs have gained an international documental traceability with this standard.

ISO 22000- food safety management system is composed of five main parts as it is seen in the Figure 2.5. These parts are the documentation of food safety management system, management responsibility, resource management, planning safe product and carrying out it and the validation, confirmation and improvement of food safety management system. The food safety management system starts with the planning of senior management (matter/clause 5) and continues with resource management (matter/clause 6) in which the resources that these plans need are provided. The next step is to plan safe products and carry out it (matter/clause 7). In this part, there are pre-requisite programs which HACCP needs, the first stages of doing preliminary hazard analysis, danger and risk analysis and HACCP plan. The stages of planning food safety management system related to traceability system and how to control nonconformities are involved in this clause. The validation, confirmation and improvement of food safety management system are explained in the clause 8. The confirmation of food safety system is done via internal audits as it is in the ISO 9000- quality management system standard. The disorders and needs for change that emerge are corrected by revision by senior management and the cycle perpetuates. This structure provides constant developing as it is in ISO-9000-quality management system.

2.3.4. ISO 9000-Quality Management Practices

International Standardization Organization (ISO) is an association established by national standardization organizations all around the world. This association organizes and publishes the standards needed in all the production and service areas. The standards also needed in terms of Quality Management Practices have been published and translated into a lot of languages again by this organization.

ISO 9000 standardization range was published by ISO firstly in 1987 as the international standard. TS EN ISO 9000 (TS: The Turkish Standards EN: The European Norm) is the complete translation of ISO 9000 Quality Standardization

Series published by International Standardization Organization. These standards identify what kind of conditions is needed in the Quality Systems that institutions will apply. They are applicable standards that include the common conditions which can be needed and carried out by not only a few institutions but also all the work areas.

Renewal of standards were not done between 1987 and 1994 since management practices were a new concept for the institutions which allocated quality systems based on ISO 9000 standards. The renewal carried out in 1994 was a renewal which included slight changes. It was seen that the changes had not met some of the expectations in the application since it was published. However, the renewal done in December, 2000 includes developments in quality field and radical changes which are gained through experiences from ISO 9000. The standard of quality management system, ISO 9000, had always been revised by the organization and current basic frame took its final form in 2000. In 2008, some changes were made in the standard.
ISO 9000 Quality Management System encourages process approach in improving and applying of the quality management system, and increasing its efficiency in order to meet the expectation of the customers and enhance customer satisfaction. Applying the system of processes in the organization, with defining and managing of these processes and their interaction are called "Process Approach". The advantage of the process approach is that it provides a control over both connection among processes with individual system and all of these and their interaction composed by processes.

The process is a group of activities which have inputs (raw material, information etc.) and present these inputs as outputs (afterproduct, service etc.) to internal customers or external customers by adding values to them. These activities are related to each other with logical relationships. They provide necessary condition in achieving aims by using sources of the organization. It is a plain form of management where work-flows of production among functional units in the institution come into prominence independent from hierarchical structure. It is an effective form of management where incomes and outcomes in which responsibilities of workers become clearer are clearly expressed, criteria of performance and the extent of success can be measured and a constant improvement are provided.

The standard of ISO 9000- Quality Management System is composed of five main chapters as it is in the Figure 2.5. These chapters are the documentation of quality management system, management responsibility, resource management, manufacturing products and/or operating service, and measuring them and analyzing and developing. In the Figure 2.5, it is also known the form of Deming Cycle. The quality system starts with the planning of senior management (matter/clause 5) and continues with resource management (matter/clause 6) in which the resources that these plans need are provided. The next step is to manufacture products and/or to operate service (matter/clause 7). After this step, products and services are needed to be examined (matter/clause 8). The disorders and needs for change that emerge are corrected by revision by senior management and the cycle perpetuates. This structure provides constant developing.

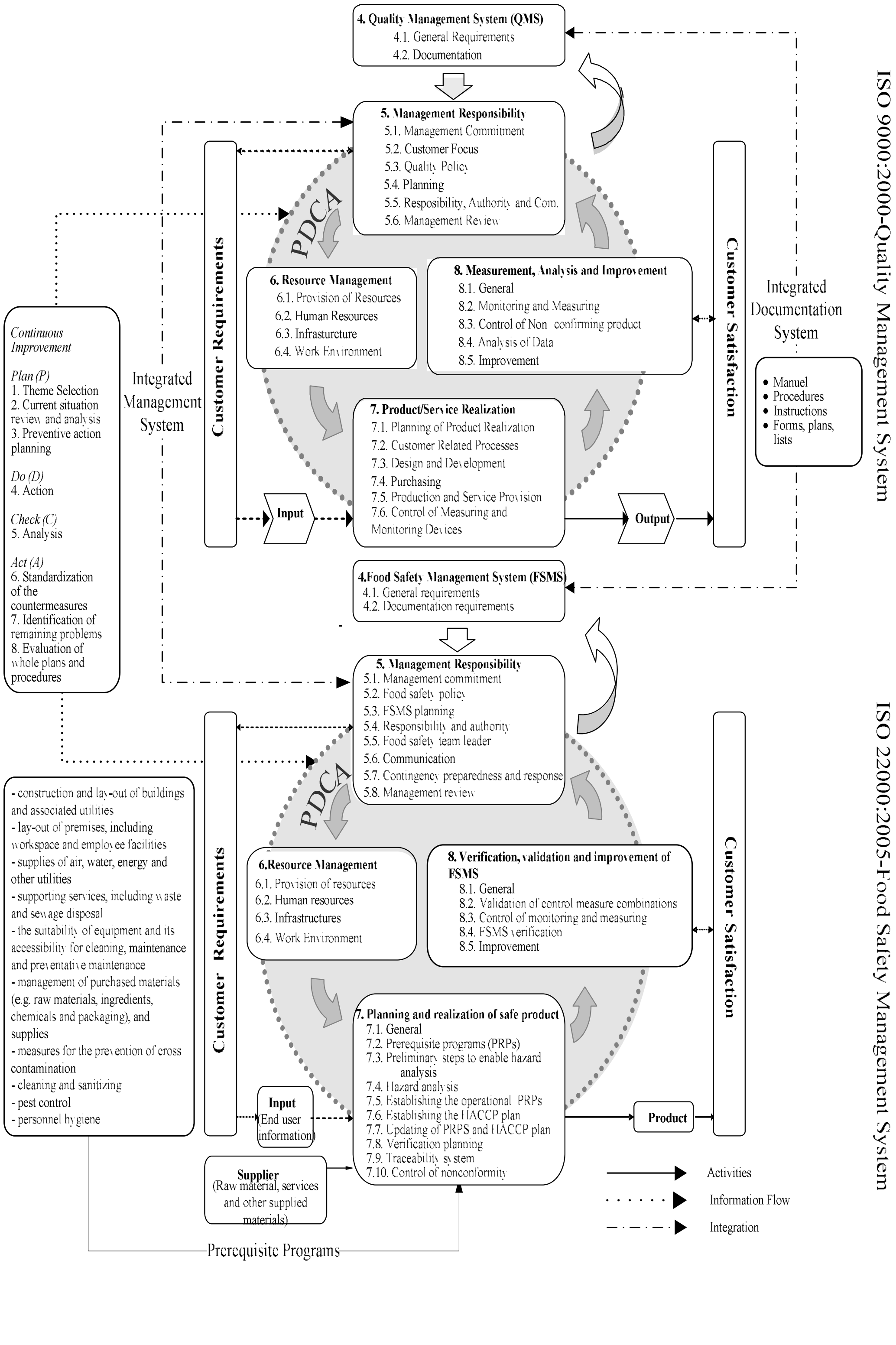


Figure 2.5 Continuous Improvement Models in ISO 22000-Food Safety Management System and ISO 9000-Quality Management System [2].

2.4. Small and Medium Sized Food Enterprises in Turkey

These three sectors whose economic value and amount of production have kept on increasing for years also cause increase in exportation. The number of exporters and the amount of the exportation which is done are given as shown in Table 2.4 for Turkey overall and in Table 2.5 for Gaziantep and its region.

Table 2.4 The assesment of sectorial exportation in Turkey [35]

		Pistachio	Bulgur	Red pepper
2006	Exporter	279	257	171
	Quantity (tons)	1685	59512	813
2007	Exporter	265	233	156
	Quantity (tons)	1669	73211	607
2008	Exporter	265	233	144
	Quantity (tons)	1581	73.041	606
2009	Exporter	267	306	167
	Quantity (tons)	2051	115.586	1141
2010	Exporter	259	283	467
	Quantity (tons)	1233	164.554	830

Table 2.5 The assesment of sectorial exportation in Gaziantep [36]

		Pistachio	Bulgur	Red pepper
2006	Exporter	46	46	21
	Quantity (tons)	365	24653	79
2007	Exporter	53	52	21
	Quantity (tons)	415	41503	106
2008	Exporter	55	48	13
	Quantity (tons)	452	41682	76
2009	Exporter	53	47	24
	Quantity (tons)	603	29232	120
2010	Exporter	53	46	24
	Quantity (tons)	389	39561	230

CHAPTER III

MATERIAL AND METHOD

3.1. Material

The survey of pre-requisite conditions were conducted towards small and medium sized enterprises which were five red pepper plants in Kahramanmaraş, twenty one pistachio and eighteen bulgur plants in Gaziantep (Table 3.1). While choosing these enterprises, the current situation of enterprises, the work capacity, flows of work and business capacity were taken into account. In addition, registration information of enterprises were taken from Gaziantep Provincial Directorate of Agriculture and surveys were done by concealing private information about enterprises.

Table 3.1 The number of plants and survey in the region

Products	Number of Plants	Number of Surveys	Sampling Percent
Pistachio	228	21	9
Bulgur	39	18	46
Red Pepper	71	5	7

3.2. Method

3.2.1. Preparation of Survey

Questions were developed based on guidelines of the ISO 22000-Food Safety Management Systems Standard. A written questionnaire which consists of three parts was developed specially for this study. Part I included 4 questions related to food businesses (such as number of certificate, implementation of ISO 9000-QMS and ISO 22000-FSMS standards). Part II included evaluating questions related with production technologies and their control activities of pistachio, bulgur and red pepper processing. Part III consists of 89 questions related with pre-requisite programs (such as measures for the prevention of cross contamination, cleaning and sanitizing, pest control personnel hygiene). The first and second part questions were open questions, meaning that responents had to explain in their own words what they understood by the business and their processing technologies. Part III questions were asked to choose from among three options – yes, no, and don't know.

This survey was conducted from September 2009 to May 2010 involving 21 pistachio (Gaziantep), 18 bulgur (Gaziantep) and 5 red pepper (Kahramanmaraş) processing plants in Turkey. Each plants were visited by a person trained in HACCP and pre-requisite programs, conducting face to face interviews and administrating questionnaire. The results were evaluated and analysed using the Microsoft Excel spread sheet.

3.2.2. Survey

The way of conducting survey: pistachio, bulgur and red pepper enterprises were visited and conducted towards the personnel who is responsible for production.

3.2.3. Method of Evaluation of Survey

The analysis below was done for all the three products in assessment of surveys:

- The analysis of documentarial state of enterprises
- The analysis of production technologies of enterprises
- The potential threats in processing lines
- Considering pre-requisite under condition title

3.2.4. HACCP Study

All potential hazards in each processing lines were listed. A decision tree (Figure 3.1) was used to determine the significant hazard in each processing steps [36].
The cause and effect diagram (Figure 3.2) (also known as Ishikawa, tree diagram and fishbone diagram) was used in order to show the underlying causes of failures in bulgur, pistachio and red pepper manufacturing.

Hazard assessment following the hazard analysis was quantified by using five-class hazard scoring matrix. The control measures in each steps were classified and determined (Table 3.2).

Table 3.2 Five-class hazard scoring matrix

Severity			Risk Classes				
Catastrophic	Death or lasting damage	E	3	4	4	4	4
Critical	Many concerned people and lasting or continuous damages	D	3	3	4	4	4
Serious	Many concerned people, no lasting damages	C	2	3	3	4	4
Low	Single case, no lasting damages or minimal concentration	B	2	2	3	3	4
Ignorable	Hazard to be discovered prior to consumption or minimal indisposition	A	1	2	2	3	3
			I	II	III	IV	V
Probability			Unlikely (< per 1 years)	Rare (per year)	Occasional (per semester)	Frequent (per month)	Very frequent (per week)

Risk classes	Control measures
1	1. No measure necessary.
2	2. Periodic measures are measures which often cover a one-time activity.
3	3. General control measures and prerequisite programs
4	4. Specific control measures are specifically developed and used to control the risk.

Critical control points of bulgur, pistachio, and red pepper processing were determined. A decision tree (Figure 3.3) was used to determine the steps which could be designated as critical control points [37].

The HACCP plan was documented and included the following information for each identified critical control point (CCP):

a) food safety hazard(s)

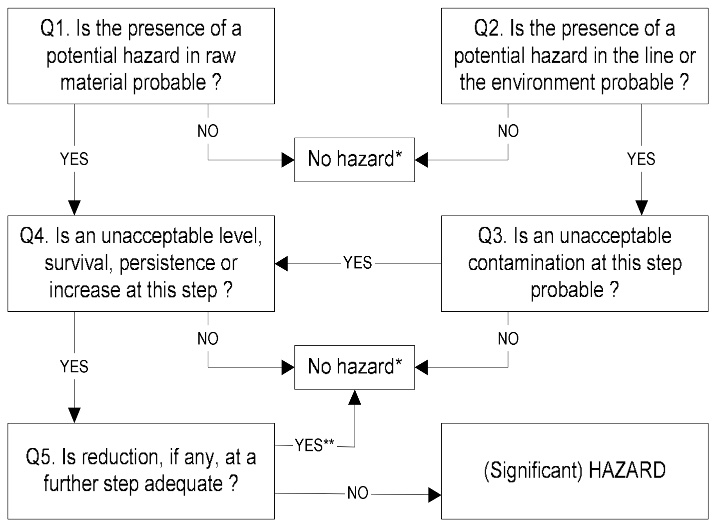
b) control measure(s)

c) critical limit(s)

d) monitoring procedure(s)

e) corrective action(s)

f) responsibilities and authorities;



(*Not a hazard to be controlled at this step, **Reduction step thus becomes a CCP)

Figure 3.1 Hazard analysis (decision tree) [36] .

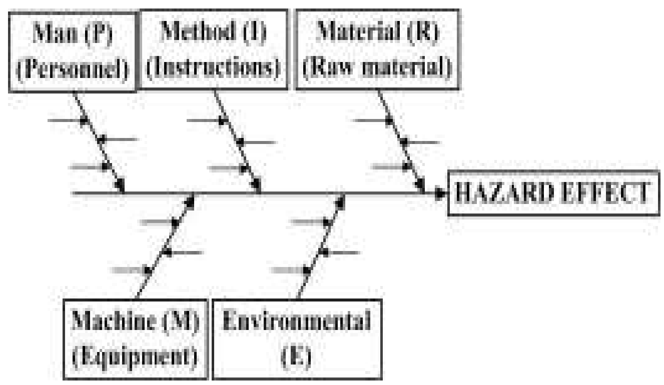


Figure 3.2. Cause and effect analysis (Fish bone diagram).

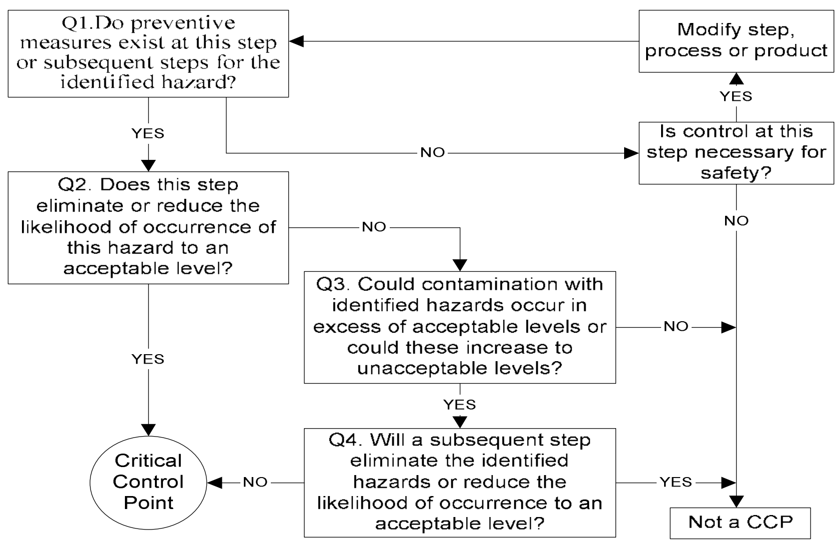


Figure 3.3 Decision tree to identify critical control points [37]

3.2.5. Quality Study

Quality hazards were listed. Quality control points were determined by decision tree (Figure 3.4). The quality plan was documented and included the following information for each identified quality control point (QCP):

a) quality hazard(s)

b) limit(s)

c) monitoring procedure(s) including method, frequency and responsible

d) corrective action(s)

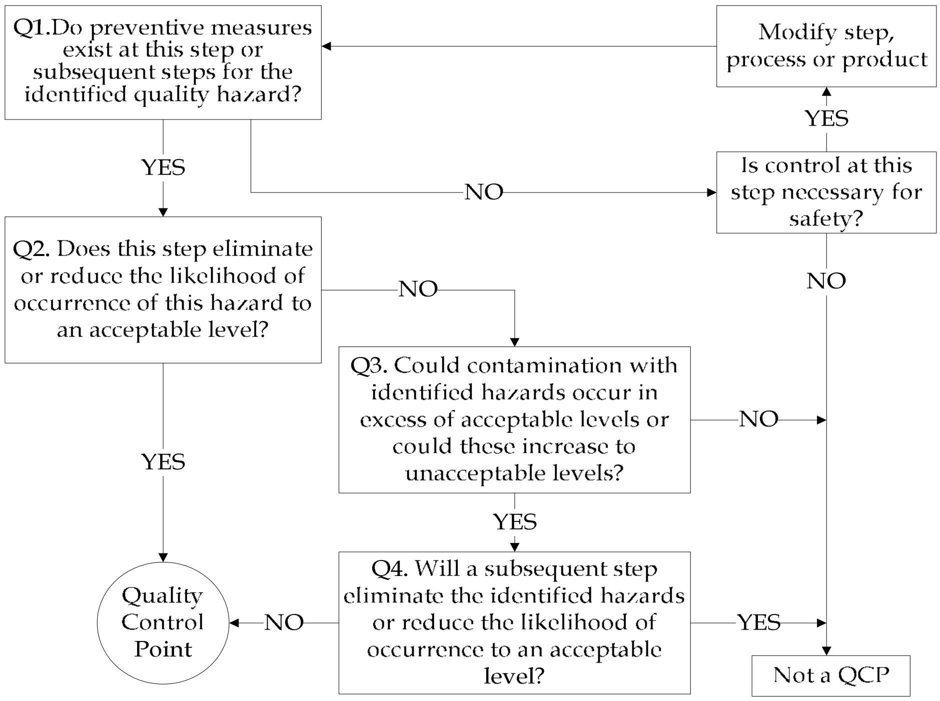


Figure 3.4. Quality control points analysis (Decision tree)

CHAPTER IV

RESULT AND DISCUSSION

4.1. Small and Medium Sized Food Enterprises

The aim for choosing pistachio, bulgur and red-pepper in this study was that these products were regionally belonging to South Eastern Anatolia, and their value-added was high. In addition, that agricultural encouragements were common in our country's exportation in order to increase competition power of these sectors in international markets encourages operations to be careful about food safety. To this end, it was aimed to offer suggestions for solution to problems of the sector so as to be able to minimize problems of plants about food safety.

4.2. Accreditation Structure

While the number of plants which have ISO 9000 certificate is 38 % , the number of plants which have ISO 22000 is 57 % in the sector pistachio. This situation indicates that the sector is more inclined to its own standard. Additionally, operations regard these standards as a guide to increasing customer satisfaction and reaching the targets of food safety. However, it is seen that the product certificate of Turkish Standards Institution (TSE) is very low (19 %) and there are almost no certificates that are more specific, such as British Retail Consortium (BRC) and International Food Standart (IFS) (5 %) (Table 4.1).

In the sector Bulgur, while the number of plants which have ISO 9000 certificate constitutes a part with 56 %, the part with 50 % has ISO 22000. TSE product certificate which is given as an efficiency certificate for production is taken by nearly 17 % of the plants.

The distribution of certificates is given in the Table 4.1 and it is seen that as sectorial, over half of the operations have permission for production.

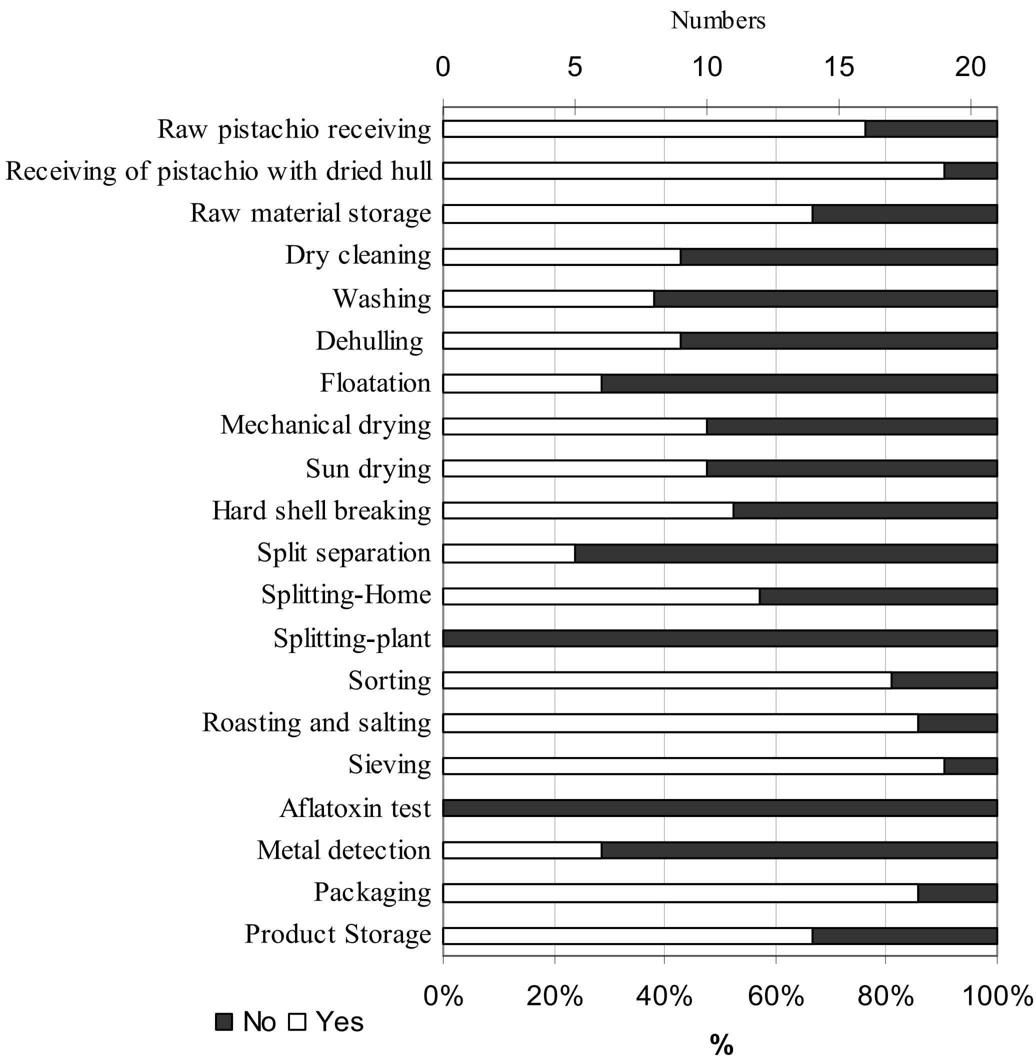
Table 4.1 The number and percentage of certificated plants

Certificates	Pistachio(n=21)	Bulgur(n=18)	Red Pepper(n=5)
ISO 9000-QMS	8 (38)	10 (56)	3 (60)
ISO 22000-FSMS	12 (57)	9 (50)	5 (100)
TSE certificate	4 (19)	3 (17)	2 (40)
Certificate in food Production	17 (81)	14 (78)	5 (100)
BRC, IFS; etc	1 (5)	0	0

4.3. Process Technologies and Pre-requisities

4.3.1. Pistachio Processing and Pre-requisities

Most of the small-sized and medium-sized pistachio operations prefer taking raw materials to factory in the form of dried and hard-shell (90 %) as it seen in Figure 4.1. Mechanical drying and drying in the sun are preferred at same rates in the process of drying pistachios after cleaning pistachios (50 %). Cost and quality policies of operations are responsible for this preference. The process of splitting pistachios is usually done at home because there is not qualified equipment, and there is much losses during splitting. Standardization is important for the process of roasting pistachios to be of good quality. Therefore, 80.1 % of the operations do sizing for a homogeneous roasting (Figure 4.1). Aflatoxin test is recommended as a separate processing step in this study as it is seen in the flow diagram (Figure 4.1). The reason why aflatoxin test is recommended as a processing step is to make it possible to observing aflatoxin which can form in the course, which last to this test, at only one step rather than analyzing it at every step. Yet, according to surveys, aflatoxin test is not carried out in any operation at this step (Figure 4.1).



n_Y : number of YES answer; n_N : number of NO answer

Figure 4.1 Evaluation of pistachio processing steps in Turkey (n=21)

Pre-requisits programs are evaluated in terms of subjects and the number of questions (Table 4.2). There are the numbers and the percentages of yes/no which is obtained by asking all questions (n_{QT}=86) to all operations (n_f=21) in this table. The questions related to pre-requisities are pared by being categorized into head titles and these questions are got answered by wandering in plants. It is seen that the protection of operations against environmental contaminations is ensured at the rate of 90 %, and pollutions in buildings are cared at the rate of 88 %. It is seen in the Table 4.2 that the order of social ambient of staffs and the matter of hygiene are remarked at the rate of 89 % in operations. Furthermore, it is understood that maintenance of equipment of pistachio production operations is cared in terms of the costs and lifetime (Table 4.2)

Table 4.2 Pre-requisite program check list for pistachio processing

Observed practices	Respondents			
	n_Q	n_Y (%)	n_N (%)	n_U (%)
I. Construction and lay-out of buildings and associated utilities				
Closeness to the environmental contamination zones	1	13 (62)	7 (33)	1 (5)
Protection against environmental contamination situation	6	114 (90)	11 (9)	1 (1)
Floors and walls of buildings across the state of internal	4	74 (88)	8 (10)	2 (2)
II. Layout of premises, including workspace and employee facilities				
Arrangement of workspaces plan	3	54 (85)	8 (13)	1 (2)
Production flow lines	3	52 (83)	9 (14)	2 (3)
Lightening of production spaces	3	53 (84)	9 (14)	1 (2)
Drains	2	39 (93)	3 (7)	0 (0)
Personal hygiene zones	5	93 (89)	11 (10)	1 (1)
Employee facilities	3	60 (95)	3 (5)	0 (0)
III. Supplies of air, water, energy and other utilities				
Water supply	6	104 (83)	17 (13)	5 (4)
Ventilation	2	36 (85)	4 (10)	2 (5)
IV. Supporting services, including waste and sewage disposal	7	125 (85)	15 (10)	7 (5)
V. The suitability of equipment and its accessibility for cleaning, maintenance and preventative maintenance				
Design and suitability of equipments	6	111 (88)	8 (6)	7 (6)
Maintenance and repair program	1	15 (71)	5 (24)	1 (5)
Control of measurement and monitoring equipments	1	16 (76)	3 (14)	2 (10)
VI. Management of purchased materials, supplies, disposals and handling of products				
Food transportation systems against environmental compliance	5	99 (94)	4 (4)	2 (2)
Control of food transport systems	4	72 (85)	9 (11)	3 (4)
Food storage areas, layout	3	52 (82)	10 (16)	1 (2)
Control of storage	5	94 (89)	4 (4)	7 (7)
VII. Measures for the prevention of cross contamination	2	32 (77)	9 (21)	1 (2)
VIII. Cleaning and sanitizing	2	38 (91)	3 (7)	1 (2)
IX. Pest control	3	55 (87)	6 (10)	2 (3)
X. Personnel hygiene				
Traning programs	4	64 (76)	15 (18)	5 (6)
Personal hygiene practices	8	143 (85)	14 (8)	11 (7)

n_Q: number of question; n_Y : number of YES answer; n_N : number of NO answer; n_U : number of uncertain answer

It is seen in Table 4.3 and Figure 4.2 where pre-requisite programs are evaluated that the pre-requisite numbered as 8 is applied in all the operations (91 %). In contrast, the pre-requisite numbered as 7 has the lowest rate. The reason for this situation is that they do not have necessary equipment for food safety and they do not always have responsible executives. In table 4.3, the plants numbered as 7 (100 %) and 11

(99 %) have the highest rate in assessing pre-requisite programs of plants. In contrast, the plant numbered as 13 (53.2 %) have taken the lowest score. Factors in this situation are that they do not have necessary equipment for wasting system, material and product storing, cross infection and insects.

Table 4.3 Evaluation of pistachio processing plant in Turkey

Plants	Pre-requisite programs (%)										P_p
	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	
1	90.9	94.7	75.0	85.7	100.0	100.0	100.0	100.0	100.0	100.0	94.6
2	90.9	89.5	75.0	100.0	100.0	88.2	100.0	100.0	100.0	100.0	94.4
3	90.9	84.2	75.0	85.7	75.0	100.0	100.0	100.0	100.0	75.0	88.6
4	72.7	89.5	100.0	85.7	87.5	94.1	100.0	100.0	100.0	91.7	92.1
5	90.9	89.5	87.5	71.4	62.5	94.1	100.0	100.0	100.0	83.3	87.9
6	63.6	73.7	87.5	100.0	62.5	76.5	100.0	100.0	100.0	66.7	83.1
7	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
8	100.0	84.2	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	98.4
9	90.9	84.2	100.0	71.4	87.5	88.2	50.0	100.0	100.0	100.0	87.2
10	100.0	100.0	100.0	100.0	87.5	100.0	100.0	100.0	100.0	83.3	97.1
11	100.0	94.7	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.5
12	100.0	94.7	75.0	100.0	87.5	100.0	100.0	100.0	100.0	100.0	95.7
13	81.8	84.2	62.5	57.1	62.5	58.8	0.0	50.0	0.0	75.0	53.2
14	81.8	78.9	62.5	71.4	75.0	70.6	50.0	50.0	33.3	25.0	59.9
15	54.5	78.9	25.0	71.4	12.5	70.6	100.0	100.0	100.0	75.0	68.8
16	81.8	78.9	75.0	85.7	100.0	94.1	50.0	100.0	33.3	91.7	79.1
17	90.9	94.7	100.0	71.4	100.0	94.1	100.0	100.0	100.0	100.0	95.1
18	72.7	63.2	62.5	85.7	87.5	94.1	50.0	50.0	66.7	66.7	69.9
19	90.9	94.7	87.5	85.7	87.5	82.4	50.0	100.0	100.0	91.7	87.0
20	90.9	100.0	100.0	100.0	100.0	100.0	50.0	100.0	100.0	100.0	94.1
21	90.9	89.5	100.0	57.1	100.0	58.8	0.0	50.0	100.0	0.0	64.6
n_Q	11	19	8	7	8	17	2	2	3	12	
P_p	87.0	87.7	83.3	85.0	84.5	88.8	76.2	90.5	87.3	82.1	85.24

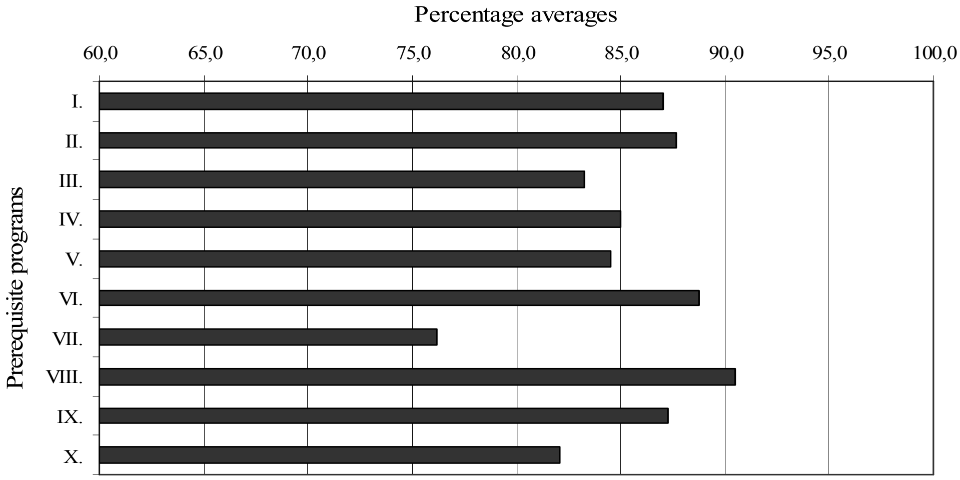


Figure 4.2 Evaluation of pre-requisite programs for pistachio processing plants in Turkey

It is seen in Figure 4.3 which is considered as pre-requisite conditions of pistachio production process that the plants numbered as 7 and 11 apply almost 100 % of necessary conditions. Again, it is seen that providing necessary provisions for pre-requisite conditions of plants is the highest in the Table 4.3.

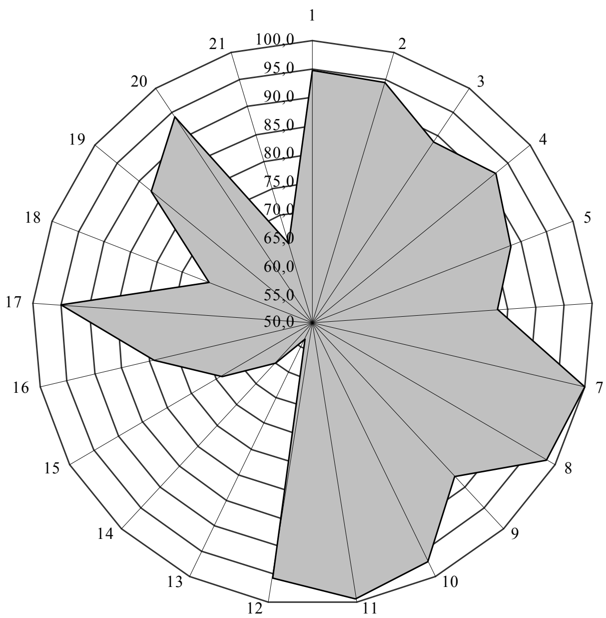
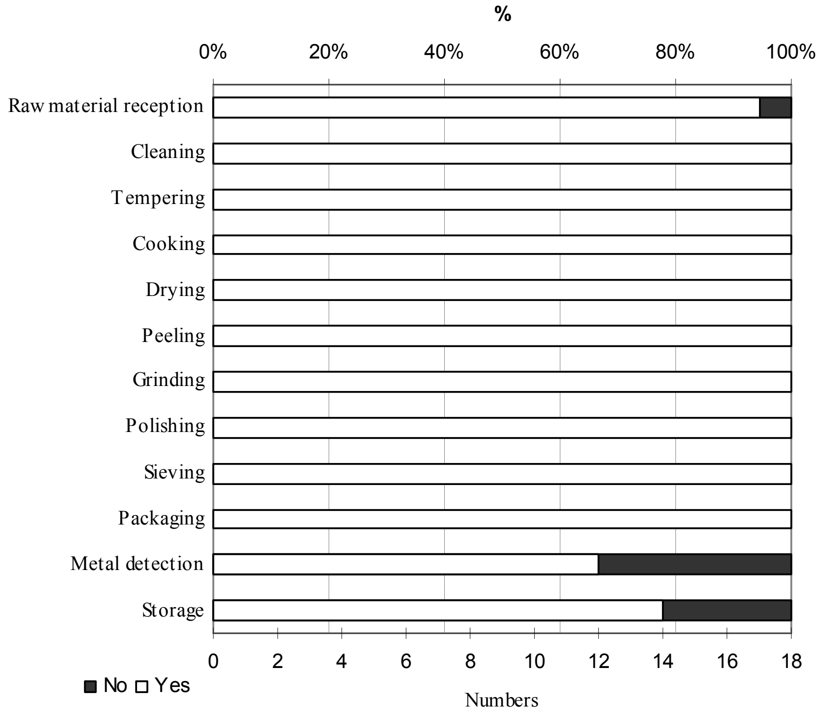


Figure 4.3 Evaluation of pistachio processing enterprises in Turkey

4.3.2. Bulgur Processing and Pre-requisities

It is seen in Figure 4.4 that small-sized and medium-sized bulgur producers apply most of the course steps of production. It is understood from survey results that taking raw material is done in over 80 % of all operations, and cleaning and cooking are done in all the operations. Drying process is generally done in driers sorted as rotary or tower. Bulgur operations regard the method drying in the sun as an old method, and prefer it only for those whose economic value is low. As it is seen in Figure 4.4, all of the operations use the drying method. The milling step with stone grinding machine is important for the sake of preserving its yellow color, its oval shape and its size, and it is done in 100 % of operations. Metal detector is used in 60 % of operations, and high costs are responsible for this situation.



n_Y : number of YES answer; n_N : number of NO answer

Figure 4.4 Evaluation of bulgur processing steps in Turkey (n=18)

Pre-requisite programs are evaluated in terms of their subject and the number of questions (Table 4.4). There are the numbers and the percentages of yes/no which is obtained by asking all questions (n_{QT}=87) to all operations (n_p=18) in this table. The questions related to pre-requisities are prepared by being categorized into head titles and these questions are got answered by wandering in plants. It is seen that the protection of operations against environmental contaminations is ensured at the rate of 86 % in 18 plants, and pollutions in buildings are cared at the rate of 89 % . It is seen in the Table 4.4 that the order of social ambient of staffs and the matter of hygiene are remarked at the rate of 78 % in operations, but the building and the extensional areas are more cared. That they are not educated in the subjects such as hygiene and sanitation is responsible for this situation. Furthermore, it is understood that maintenance of equipment of pistachio production operations is cared at the rate of 100 % in terms of the costs and lifetime (Table 4.4).

Table 4.4 Pre-requisite program check list of bulgur

	Observed practices	Respondents			
		n_Q	n_Y (%)	n_N (%)	n_U (%)
I.	Construction and lay-out of buildings and associated utilities				
	Closeness to the environmental contamination zones	1	13(87)	2(13)	0(0)
	Protection against environmental contamination situation	6	92(86)	15(14)	0(0)
	Floors and walls of buildings across the state of internal contaminations	4	64(89)	8(11)	0(0)
II.	Lay-out of premises, including workspace and employee				
	Arrangement of workspaces plan	3	51(94)	3(6)	0(0)
	Production flow lines	3	49(91)	5(9)	0(0)
	Lightening of production spaces	3	50(93)	4(7)	0(0)
	Drains	2	35(97)	1(3)	0(0)
	Personal hygiene zones	5	69(78)	19(21)	1(1)
	Employee facilities	3	47(87)	6(11)	1(2)
III.	Supplies of air, water, energy and other utilities				
	Water supply	6	88(81)	20(19)	0(0)
	Ventilation	2	28(78)	7(19)	1(3)
IV.	Supporting services, including waste and sewage disposal	7	106(84)	19(15)	1(1)
V.	The suitability of equipment and its accessibility for cleaning, maintenance and preventative maintenance				
	Design and suitability of equipments	6	102(94)	4(4)	2(2)
	Maintenance and repair program	1	15(83)	3(17)	0(0)
	Control of measurement and monitoring equipments	1	18(100)	0(0)	0(0)
VI.	Management of purchased materials, supplies, disposals and handling of products				
	Food transportation systems against environmental	5	89(99)	1(1)	0(0)
	Control of food transport systems	4	68(94)	3(4)	1(1)
	Food storage areas, layout	3	38(70)	15(28)	1(2)
	Control of storage	3	54(100)	0(0)	0(0)
VII.	Measures for the prevention of cross contamination	2	32(89)	4(11)	0(0)
VIII.	Cleaning and sanitizing	2	18(50)	14(39)	4(11)
IX.	Pest control	3	47(87)	6(11)	1(2)
X.	Personnel hygiene				
	Traning programs	4	52(72)	20(28)	0(0)
	Personal hygiene practices	8	126(88)	18(13)	0(0)

n_Q: number of question; n_Y : number of YES answer; n_N : number of NO answer; n_U : number of uncertain answer

It is seen in the Table 4.5 and Figure 4.5 where pre-requisits programs are evaluated that the pre-requisities numbered as 5 and 6 are extensively applied in all operations (92,9 %). In contrast, the pre-requisite numbered as 8 has gotten the lowest rate. The reason for this situation is that they do not give necessary importance to hygiene and sanitation procedure, and it is understood that only a slight number of plants have subcontractor plants do this job. Furthermore, that the responsible executives in operations are not so effective in operations makes the managing mentality of operations clearer. In Table 4.5, the plants numbered as 5 (96.6 %) and 18 (97.7 %) have the highest rate in assessing pre-requisite programs of plants in percentages. In contrast, the plant numbered as 16 (70.1 %) have taken the lowest score. Factors in this situation are insufficient knowledge about crosswise infection, indifference towards cleaning and disinfection, and that effective methods for fight against harmful organisms are not assigned.

Table 4.5 Evaluation of bulgur processing plant in Turkey

Plants	Pre-requisite programs (%)										
	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	Pp
1	81.8	84.2	75	100	100	93.3	100	100	100	100	90.8
2	81.8	94.7	88	100	87.5	86.7	100	100	100	100	92
3	90.9	100	100	85.7	100	93.3	100	50	100	100	95.4
4	63.6	73.7	88	85.7	87.5	100	100	100	100	83	83.9
5	90.9	100	100	85.7	100	100	100	100	100	92	96.6
6	90.9	100	88	85.7	100	100	100	0	66.7	100	93.1
7	63.6	73.7	63	71.4	100	86.7	100	50	100	83	78.2
8	63.6	89.5	100	100	62.5	93.3	100	50	100	100	87.4
9	72.7	78.9	63	85.7	100	86.7	100	50	100	83	81.6
10	100	84.2	88	100	100	86.7	100	50	100	100	92
11	100	94.7	63	85.7	100	93.3	100	50	66.7	67	86.2
12	90.9	94.7	100	85.7	100	93.3	100	50	100	100	94.3
13	81.8	89.5	100	100	100	100	100	50	100	92	93.1
14	90.9	78.9	63	42.9	87.5	86.7	100	0	66.7	42	71.3
15	81.8	89.5	75	42.9	87.5	86.7	0	0	66.7	42	71.3
16	100	78.9	50	71.4	87.5	80	0	0	33.3	50	70.1
17	90.9	84.2	63	85.7	87.5	93.3	100	0	66.7	50	78.2
18	100	94.7	88	100	100	100	100	100	100	100	97.7
nq	11	19	8	7	8	15	2	2	3	12	
Pp	86.7	88.0	80.6	84.1	93.8	92.2	88.9	50.0	87.0	82.4	83.37

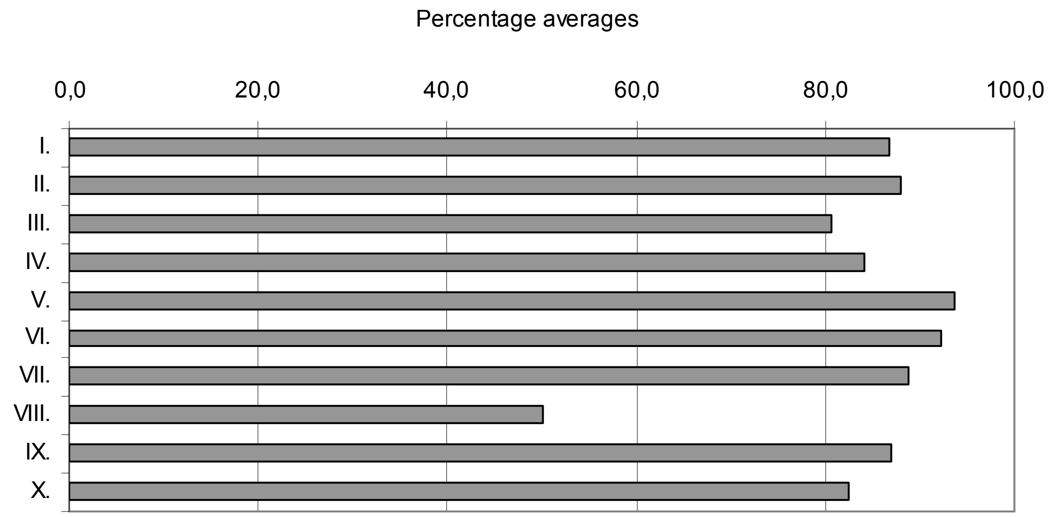


Figure 4.5 Evaluation of pre-requisite programs for bulgur processing plants in Turkey.

It is seen in Figure 4.6 which is considered as the flow diagram of bulgur production process that the plants numbered as 5 and 18 apply this process at the rate over 95 %. Again, it is seen that the necessary provisions for providing pre-requisite conditions are highest in the Table 4.5 for the same plants.

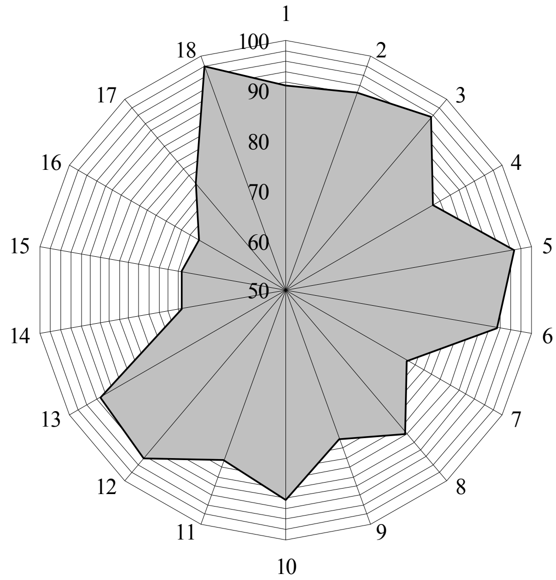
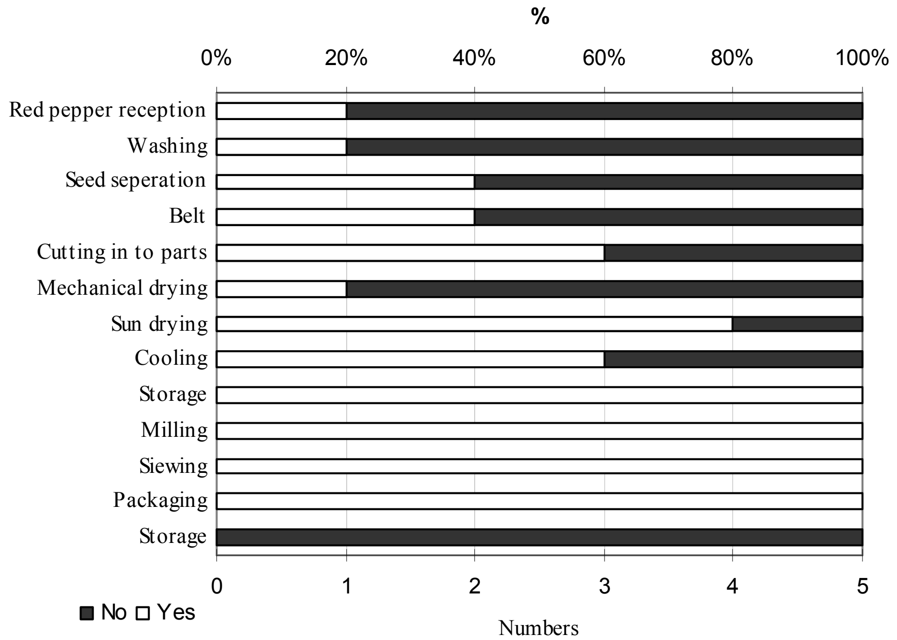


Figure 4.6 Evaluation of bulgur processing enterprises in Turkey

4.3.3. Red Pepper Processing and Pre-requisities

It is seen in Figure 4.7 that small-sized and medium-sized red-pepper producers do not completely apply course steps of production. It is understood from survey results that taking raw material, cleaning and separating processes are not done in 80 % of operations, but raw material which is cleaned before is taken to factory at the rate of 60 % for the purpose of breaking into pieces. Financial factors and that operations are small in size are responsible for this situation. Drying process of red-pepper is generally done in sun by spreading them ground. The small-sized and medium-sized red-peppers operations employ the drying-in-the-sun method with a rate of 80 % as it is seen in Figure 4.7. Some operations buy them as dried pepper and brake them as semi-finished product. The process of grinding red-pepper is done in all operations at rate of 100 %. Packaging and sieving are done in all operations according to particle size, but operations do not do storing because 100 % of red-pepper producers make hot sale (Figure 4.7).



n_Y : number of YES answer; n_N : number of NO answer

Figure 4.7 Evaluation of red pepper processing steps in Turkey (n=5)

Pre-requisit programs are evaluated in terms of their subject and the number of questions (Table 4.6). There are the numbers and the percentages of yes/no which is obtained by asking all questions (n_{QT}=89) to all operations (n_p=5) in this Table. It is seen that the protection of operations against environmental contaminations is ensured at the rate of 80 % in 5 plants, and pollutions in buildings are cared at the rate of 95 % . It is seen in the Table 4.6 that the order of social ambient of staffs and the matters of their own hygiene are remarked at the rate of over 80 % in operations, and salvaging waste materials is cared much (100 %). It is understood that maintenance of equipment of red-pepper production operations is cared at the rate of 80 % in terms of the costs and lifetime. The Table 4.6 shows that operations have insufficient knowledge about cleaning, sanitation and crosswise infection (40 %) and they are not conscious of food safety.

Table 4.6 Pre-requisite program check list of red pepper

	Observed practices	Respondents			
		n_Q	n_Y (%)	n_N (%)	n_U
I.	Construction and lay-out of buildings and associated utilities				
	Closeness to the environmental contamination zones	1	1(20)	4(80)	0(0)
	Protection against environmental contamination situation	6	25(83)	5(17)	0(0)
	Floors and walls of buildings across the state of internal	4	19(95)	1(5)	0(0)
II.	Lay-out of premises, including workspace and employee				
	Arrangement of workspaces plan	3	11(73)	3(20)	1(7)
	Production flow lines	3	14(93)	1(7)	0(0)
	Lightening of production spaces	3	8(53)	5(33)	2(13)
	Drains	2	10(100)	0(0)	0(0)
	Personal hygiene zones	5	20(80)	5(20)	0(0)
	Employee facilities	3	14(93)	1(7)	0(0)
III.	Supplies of air, water, energy and other utilities				
	Water supply	6	23(77)	2(7)	5(17)
	Ventilation	2	9(90)	1(10)	0(0)
IV.	Supporting services, including waste and sewage disposal	7	17(49)	12(34	6(17)
V.	The suitability of equipment and its accessibility for cleaning, maintenance and preventative maintenance				
	Design and suitability of equipments	6	28(93)	1(3)	1(3)
	Maintenance and repair program	1	4(80)	1(20)	0(0)
	Control of measurement and monitoring equipments	1	5(33)	5(33)	5(33)
VI.	Management of purchased materials, supplies, disposals and handling of products				
	Food transportation systems against environmental compliance contaminations	5	19(76)	6(24)	0(0)
	Control of food transport systems	4	18(90)	2(10)	0(0)
	Food storage areas, layout	3	15(100)	0(0)	0(0)
	Control of storage	5	14(93)	1(7)	0(0)
VII.	Measures for the prevention of cross contamination	2	4(40)	1(10)	5(50)
VIII.	Cleaning and sanitizing	2	4(40)	0(0)	6(60)
IX.	Pest control	3	13(87)	0(0)	2(13)
X.	Personnel hygiene				
	Traning programs	4	12(60)	7(35)	1(5)
	Personal hygiene practices	8	33(83)	7(18)	0(0)

n_Q: number of question; n_Y : number of YES answer; n_N : number of NO answer; n_U : number of uncertain answer

It is seen in the Table 4.7, and Figure 4.8 where pre-requisits programs are evaluated that the pre-requisities numbered as 1, 2 and 3 are extensively applied in all operations (average 80 %). In contrast, the pre-requisities numbered as 7 and 8 has gotten the lowest rate. The reason for this situation is that they do not give necessary importance to hygiene and sanitation procedure, and it is seen that they do not know what the sources of infection to food are only a slight number of plants have subcontractor plants do this job.

In Table 4.7, the plants numbered as 1 (87 %) and 4 (93 %) have the highest rate in assessing pre-requisite programs of plants in percentages. In contrast, the plant numbered as 2 (61 %) have taken the lowest score. Factors in this situation are insufficient knowledge about crosswise infection, indifference towards cleaning and disinfection, and not being able to salvage waste materials.

Table 4.7 Evaluation of red pepper processing plant in Turkey

Plants	Pre-requisite programs (%)										
	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	Pf
1	81.8	89.5	100	100	87.5	100	50	50	100	91.7	87.4
2	81.8	68.4	50	50	100	66.7	0	0	66.7	58.3	60.9
3	72.7	73.7	87.5	87.5	75	73.3	50	50	66.7	41.7	67.8
4	100	94.7	87.5	87.5	100	100	50	100	100	91.7	93.1
5	72.7	78.9	75	75	100	100	50	0	100	91.7	81.6
n_q	11	19	8	7	8	17	2	2	3	12	
P_p	81.8	81.1	80.0	48.6	74.0	88.0	40.0	40.0	86.7	75.0	69.5

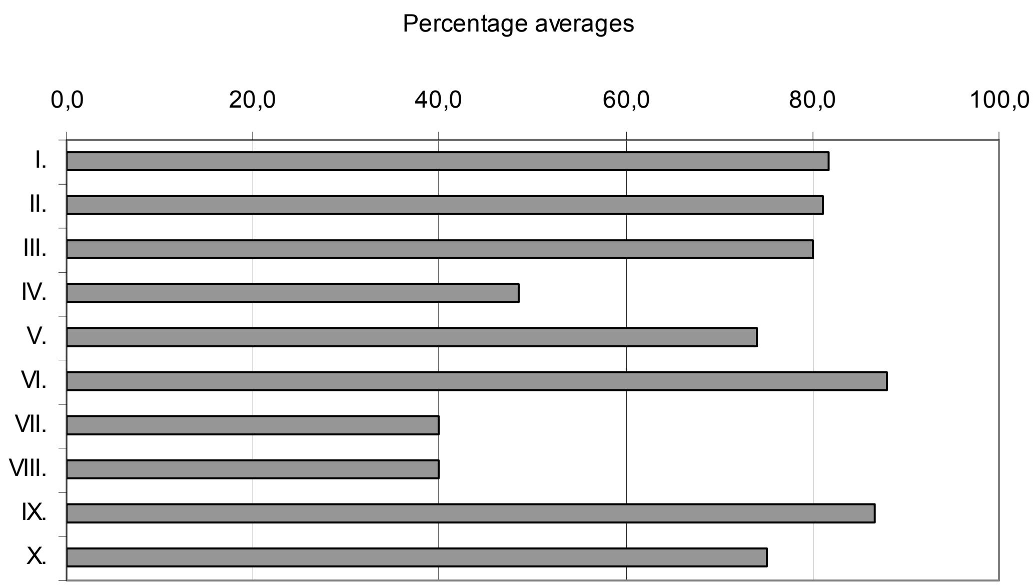


Figure 4.8 Evaluation of pre-requisite programs for red pepper processing plants in Turkey

It is seen in Figure 4.9 which is considered as the flow diagram of red-pepper production process that the plants numbered as 1 and 4 apply this process at the rate over 85 %. Again, it is seen that the provisions for providing pre-requisite conditions are highest in the Table 4.7 for the same plants.

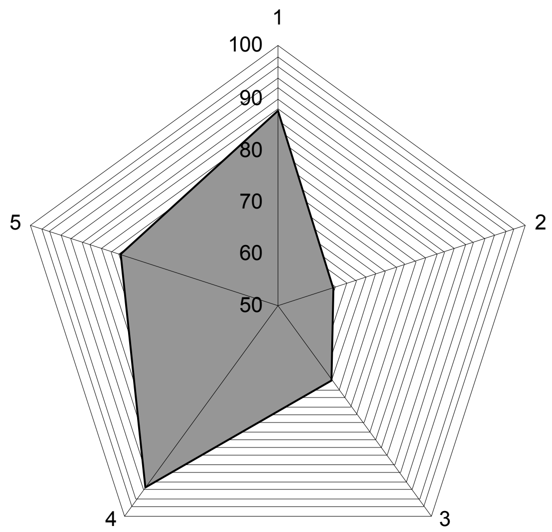


Figure 4.9 Evaluation of red pepper processing enterprises in Turkey

4.4. HACCP Study

4.4.1. Pistachio Processing

4.4.1.1. Hazard analysis of pistachio processing

The aim of hazard analysis is to collate hazards and identify the extents of hazards. Hazard analysis is done for every component, production step and HACCP one by one in identifying hazard. Steps of process and definition of process, and potential dangers and their sources are used as a base in identifying the hazard and its source in pistachio process. As it is seen in the Table 4.8, potential danger sources and classification of sources are primarily specified by using Figure 3.2 (fish bone diagram). Questions for hazard analysis are asked in each step of pistachio process by taking every danger into consideration [36, 38]. It is seen in the Table 4.8 whether hazard is important in these questions.

Pistachio production generally includes cleaning, drying, roasting and sizeing. When we look at important hazards, it is seen that they primarily stem from raw material. Raw material may include pesticide and mycotoxin (such as aflatoxin and mold). Important hazards also emerge in following steps, drying, cracking, roasting, sizing and storing. The factors in this situation are microbial infection and metal infections.

Hazard assessment following the hazard analysis must be quantified. It has been stated that hazard assessment is a mixture of probability and severity. In this study

,the probability and severity of the hazards are considered based on five–class hazard matrix. This is shown in Table 3.2. Hazard assessment and CCPs in the processing of pistachio in Table 4.9 aflatoxin content, drying and splitting processes were found to be 4th most important risk class, while the metal residue was classified as the 3rd risk class. The packaging process was classified as the 2nd risk class.

Critical control points are location, operation, procedure, or process where control can be carried out to remove the hazards for food safety or to reduce them to an acceptable level. A decision tree which is composed a series of questions and answers is used in identifying critical control points [37]. Decision tree was applied to every production step and every point where there is danger one by one. The decision tree for CCP is shown in Figure 3.3.

Critical control points of Pistachio processing were determined. Critical control points of Pistachio processing are listed on Table 4.9. After questioning the raw material reception, drying, splitting, storage and metal detection steps of pistachio processing were found to be in CCP structure. Significant hazards at those processes have to be followed by special monitoring systems.

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Table 4.8 Hazard and cause analysis for pistachio production

Process name/step	Process descriptions	Potential Hazards	Cause analysis [a] Causes (Sources and reasons)	Cause class	Hazard Analysis (Y/N) [b] Q1	Q2	Q3	Q4	Q5	SH
Raw Material Reception	Dry hulled pistachio reception	B: Mold, insects	Agricultural environment	R	Y	-	-	Y	N	Y
		C: Aflatoxin, Pesticide residue	Aflatoxin produced by mold, pesticides used in the growing of pistachio.	R	Y	-	-	Y	N	Y
		P: Foreign material	Insufficient harvesting	R	Y	-	-	Y	Y	
Raw material storage	Dry hulled pistachio storage at room temperature	B: Mold growth	Inappropriate storage conditions	I	-	Y	Y	Y	N	Y
		C: Aflatoxin		I	-	Y	Y	Y	N	Y
Cleaning	Dry and/or wet cleaning	B: Mold growth	Insufficient cleaning	I	-	Y	Y	N	-	-
		C: Aflatoxin		I	-	Y	Y	N	-	-
Dehulling	Dry and/or wet dehulling of pistachio	B: Mold growth	Insufficient dehulling process	I	-	Y	Y	N	-	-
		C: Aflatoxin		I	-	Y	Y	N	-	-
Floatation	Separation of empty pistachio	B: Mold growth	Insufficient floating process	I	-	Y	Y	N	-	-
		C: Aflatoxin		I	-	Y	Y	N	-	-
Drying	Mechanical or sun drying	B: Mold growth	The temperature and/or time of drying	I	-	Y	Y	Y	N	Y
		C: Aflatoxin		I	-	Y	Y	Y	N	Y

Continue Table 4.8.

Grading	Sizing of pistachio	P: Metal contamination	Metals contaminate during grading	I	-	Y	Y	N	-	-
Hard shell breaking and separation	For pistachio kernel processing	P: Kernel damage		I	-	N	-	-	-	N
Split separation		P:Metal contamination	Metals contaminate during splitting	I	-	Y	Y	N	-	-
Splitting	At home or in plant	B:Microbiological contamination	Microbiological contamination from humans	P	-	Y	Y	Y	N	Y
Roasting and salting	Splitted pistachios roasted at 130°C and salted by1 %	P:Metal contamination	Metals contaminate during roasting	I	-	Y	Y	Y	N	Y
Sieving		P:Metal contamination	Metals contaminate during sieving	I	-	Y	Y	Y	N	Y
Aflatoxin detection		C: Aflatoxin residue	Improper aflatoxin test	I	-	Y	Y	Y	N	Y
Metal detection		P: Metal residue	Improper metal detector	I	-	Y	Y	Y	N	Y
Packaging		P: Dirt and foreign matters	Recontamination by packaging material	R	-	Y	Y	Y	N	Y
Product storage	Roasted pistachios are stored at room temperature and 65% RH within 1 years.	B: Mold growth	Inappropriate storage conditions	I	-	Y	Y	Y	N	Y
		C: Aflatoxin		I	-	Y	Y	Y	N	Y

[a] Cause and effect analyses (Figure 3.2)

[b] Hazard analysis-Questions(Figure 3.1) [36]

Table 4.9 Hazard assessment and CCPs in the processing of pistachio

Process name/step	Significant Hazard	Hazard assesment*			Preventive actions/control measures	CCP analysis (Y/N)**				
		Severity	Probability	Risk class		Q1.	Q2.	Q3.	Q4.	CCP no:
Raw Material Reception	B: Mold, C: Aflatoxin	E	V	4	Certified suppliers with HACCP program, Aflatoxin analysis	Y	N	Y	N	CCP1
Raw material storage	B: Mold, C: Aflatoxin	E	IV	4	Aflatoxin analysis	Y	N	Y	N	CCP2
Drying	B: Survival of mold C: Aflatoxin	E	III	4	Time-temperature profile.	Y	N	Y	N	CCP3
Splitting	B:Microbiological contamination	B	V	4	Control of the cleaning schedule is correctly applied at the equipment	Y	N	Y	N	CPP4
Roasting, salting, and sieving	P: Metal contamination	A	V	3	Metal detection	Y	N	Y	Y	
Aflatoxin detection	C: Aflatoxin residue	E	II	4	Calibration	Y	Y			CCP5
Metal Detection	P: Metal residue	A	III	3	Calibration	Y	Y			CCP6
Packaging	P: Dirt and foreign matters with packaging material	A	III	2	Good manufacturing practices	Y	N	Y	N	CCP7
Storage	B: Microbial growth	B	II	2	Good storage practices	Y	N	N		GSP

* Hazard assessment (Table 3.2)
**CCP analysis-Questions(Figure 3.3) [37]

ISO 22000 Food Safety Management System Standard expects processes in operations to identify all hazards from raw material to finished product. It is necessary to make control measurements in order to reduce food safety hazards to a reasonable level or escape from them after assessing the hazard.

It is seen in the Table 4.10 that taking raw material is at the rate of 90.5 % in operations, and 33.3 % of operations cares aflatoxin test and 4.8 % of them does this test in product storing in next processing steps as control measurement in our studies conducted in operations processing pistachio. It is seen that drying process which is CCP is done in 47 % of operations, but it is done in only 14.3 % of operations so as to prevent mold growth.

Table 4.10 Control measures and pistachio processing enterprises

Process name/step	Respondents		Significant Hazard	Preventive actions/control	Respondents	
	n	%			n	%
Raw Material Reception	19	90.5	B: Mold, insects		1	4.8
			C: Aflatoxin,		7	33.3
			P: Foreign material		6	28.6
Raw material storage	14	66.7	B: Mold growth	Moisture	8	38.0
			C: Aflatoxin		0	0.0
Dehulling	9	42.9	B: Mold growth		0	0.0
			C: Aflatoxin		0	0.0
Floatation	15	71.4	B: Mold growth		0	0.0
			C: Aflatoxin		0	0.0
Drying-Mechanical	10	47.7	B: Mold growth	Moisture	3	14.3
			C: Aflatoxin		0	0.0
Drying-Sun	10	47.7	B: Mold growth	Moisture	3	14.3
			C: Aflatoxin		0	0.0
Aflatoxin test	0	0	C: Aflatoxin		0	0.0
Metal	6	28.6	P: Metal residue	Calibration	1	4.8
Packaging	18	85.7	P: Dirt, and foreign		2	9.5
Product storage	14	66.7	B: Mold growth	Moisture	5	23.8
			C: Aflatoxin		1	4.8

4.4.1.2. HACCP plan for pistachio processing

Ideally, a HACCP study should be carried out as part of product and process development, so that potential hazards can be "designed out" at the earliest stage. In any case, a HACCP study results in a HACCP plan that should be correctly implemented to ensure that the appropriate control measures are put in place before products are put on the market.

The HACCP plan is a controlled document which consists of significant hazards, critical control points, critical limits for each hazard at each CCP, monitoring procedures for each hazard at each CCP, and corrective actions if critical limits are exceeded. Some hazards are considered to be control points (CPs) because the hazards can be controlled by pre-requisite programs [36].

Critical limits are minimum and/or maximum values to which a biological, chemical, or physical parameter must be monitored at a CCP to prevent, or a food safety hazard eliminate or reduce it to an acceptable level. These limits show if the identified hazards can be put under control or not. Critical limits may be determined for factors like temperature, time, water activity, microorganism number and physical dimensions, etc. Critical limits for each critical control points for pistachio processing were evaluated on Table 4.11. These were taken from literature, legal provisions, or from comparable standard procedures.

Aflatoxin analysis of the pistachio at the time of receiving the raw material could be done by using rapid test kits for each batch.. Packaging materials can also be tested for each batch. Temperatures during the cooling, drying and roasting processes have to be monitored (Table 4.11).

Monitoring involves a systematic regularly scheduled obsevation to make sure that CCP are under control. When monitoring results show that criteria are not met, appropriate and immediate precautions should be taken to correct the deviations. For example, corrective actions may be re-heating or re-operating, increasing the operation temperature, extending operation time, decreasing pH, changing equipment of measurement, changing equipment of process and maintaining, extra training for employees, revising HACCP documents, change in process flow, etc. Procedures should be improved for corrective actions [39,40]. Monitoring results should be continuously recorded. The problems revealed in raw materials and in the pistachio processing steps should be reprocessed and corrective actions processes must be be applied. Metal detectors must be frequently calibrated and controlled for its accuracy (Table 4.11).

Table 4.11 HACCP plan for the processing of pistachio

CCP No:	Process name/step	Significant hazard	Critical limits	Monitoring			Corrective action
				Method	Frequency	Responsible	
CCP1	Raw Material Reception	B: Mold, C: Aflatoxin	*	Test kit	Each party	Lab. technician	Rejection of doubtful lot
CCP2	Raw material storage	B: Mold, C: Aflatoxin	*	Time/Temp., Moisture Content	Each run	Operator	Check/repair the storage control units
CCP3	Drying	B:Survival of mold C: Aflatoxin	*	Time/Temp., Moisture Content	Each run	Operator	Rejection of doubtful lot
CCP4	Splitting	B:Microbiological contamination	No tolerance	Microbiolojics analysis	Each run	Operator	Rejection of doubtful lot
CCP5	Aflatoxin detection	C:Aflatoxin residue	*	Aflatoxin detection	Per month	Operator	Calibration
CCP6	Metal detection	P:Metal residue	No tolerance	Metal detection	Per month	Operator	Calibration
CCP7	Packaging	P:Dirt and foreign matters with packaging material	No tolerance	Visual control	Each party	Operator	Rejection of doubtful lot

*< or = 2 μg/kg B1 for EU, < or = 20 μg/kg total aflatoxin for US (31)

Verification is the effort to determine whether the HACCP plan is valid and whether the system is operating as planned; the HACCP plan is scientifically and technically evaluated. All stages in the process should be documented in order to enable retrospective observation, verification, and validation of the HACCP system. A recording procedure should be prepared documenting the methods applied and the procedures followed. Verification should be implemented through internal audits with involves reviewing the pre-requisites, the hazards and risk assessment, critical control points, and critical limits.

The followings should be included in the HACCP plan according to the clause 7. 6. 2. of ISO 22000-FSMS; food safety hazards to be controlled at the CCP, control measures, critical limits, monitoring procedures, corrective actions to be taken if critical limits are exceeded, responsibilities, authorities and records of monitoring.

4.4.1.3. Quality control points of pistachio processing

ISO 9000:2000-QMS consisted of quality systems that focused on documenting all quality assurance and improvement processes in a company. Although the ISO 9000:2000-QMS was originally developed chedul manufacturing sector, it has been applied to many service organizations and was gaining some acceptance in the food industry. The ISO 9000:2000-QMS includes all management, production, distribution, and product design and service activities. Quality control point (QCP) means a procedure where a control can be applied and a quality hazard (for example, taste, appearance, nutrition, color) can be prevented, eliminated or reduced to acceptable levels.

ISO 9000:2000-QMS consisted of quality systems that focused on documenting all quality, percentage of split nuts, and ratio of kernel/nut (w/w). Both variety and drying conditions influence the moisture content, nut and kernel dimensions, shell appearance, split percentage and compositional changes. Kernel colour is also a characteristic of quality and reflects compositional differences, but reports on colour are relatively limited [5].

Handling of raw materials, drying, roasting, sieving, aflatoxin test and metal detection processes are analyzed as quality control points (Table 4.12).

Table 4.12 QCPs in the processing of pistachio

Process name/step	Quality Hazard	Preventive actions/control measures	QCP analysis (Y/N)*				
			Q1.	Q2.	Q3.	Q4.	QCP no:
Raw material reception	Foreign substances, color,grain number,split situation	Effective supplier assurance	Y	N	Y	N	QCP1
Raw material	Humidity and temperature of	Time and	Y	N	Y	N	QCP2
Cleaning	Foreign contaminants in enverimental	Air chedu, and water softening	Y	N	N	-	CP
Dehulling	Undehulled grain	Hektolitre gravity	Y	N	N	-	CP
Floatation	Water analysis, Moisture content	Water softening	Y	N	N	-	CP
Drying	Moisture content of pistachio	Time and temperature control	Y	Y	-	-	QCP3
Grading	Sieve control	Adjusting operation conditions	Y	N	N	-	CP
Hard shell breaking and separation	Amount of broken	Adjusting operation conditions	Y	N	N	-	CP
Split separation	Unsplitting grain	Adjusting operation conditions	Y	N	N	-	CP
Splitting	Unsplitting grain	Adjusting operation conditions	Y	N	N	-	CP
Roasting and salting	Roasting time and amount of salt	Time and temperature control	Y	N	Y	N	QCP4
Sieving	Amountof undersized/oversized grains	Adjusting operation conditions	Y	Y	-	-	QCP5
Aflatoxin	Aflatoxin test is not	Adjusting operation	Y	Y	-	-	QCP6
Metal detection	Metal detection is not	Adjusting operation conditions	Y	Y	-	-	QCP7

Continue Table 4.12

Packaging	Defective packaging	Adjusting operation conditions	Y	N	N	-	CP
Product storage	Decreasing of the shelf life	Control of the storage conditions	Y	N	N	-	CP

QCP analysis-Questions(Figure 3.4)

Quality parameters and hazards are identified after quality control points are identified. Necessary methods were applied by taking TSE as reference for limits of quality parameters. The quality limits, monitoring and corrective actions of quality parameters identified through the QCPs are given in Table 4.13.

Table 4.13 Quality plan chedul processing of pistachio

Process name/step	Quality control points	Quality parameter /hazard	Quality parameter/ limits	Monitoring			Corrective action
				Method	Frequency	Responsible	
Raw material reception	QCP1	Foreign substances, color, grain number, split ratio	Percent foreign substances	Hectoliter weight	Each Run	Operator	Reject
Raw material storage	QCP2	Humidity and temperature of storage		Moisture content	Each Run	Operator	Reject
Drying	QCP3	Moisture content of pistachio	8-13 % Moisture content	Moisture content	Each Run	Operator	Reprocess if necessary
Roasting and salting	QCP4	Roasting time and amount of salt		Colorimeter	Each Run	Operator	Reprocess if necessary
Sieving	QCP5	Amount of undersized/oversized grains	Customer requirements,clasifications	9- 9.5 mm Sieve	Each Run	Operator	Reprocess if necessary
Aflatoxin detection	QCP6	Aflatoxin test is not			Each Run	Operator	Reject
Metal detection	QCP7	Metal detection is not			Each Run	Operator	Reject

4.4.2. Bulgur Processing

4.4.2.1. Hazard analysis of bulgur processing

Hazard analysis begins with identification of food safety hazards associated with the raw material, and establishment of a priority list that is given in Table 4.14. First, a complete list of hazards that could potentially be of concern is drawn up. Cause analysis is based on determine potential hazard sources and classifying the causes [39]. This classification is done by fish bone diagram (Figure 3.2) and results are used in Table 4.14. Then, to identify significant hazards, a number of questions given in Table 4.14 have to be answered for each hazard that could be of concern at each Bulgur production step [36]. Hazard analysis starts questioning of the presence of a potential hazard whether in raw material or in the processing step. Questioning determines the hazards whether it is significant or not. Questions and questioning results are shown in Table 4.14.

According to one of the main hazards comes from properties of raw material (Table 4.14). Raw material may contain pesticides and mycotoxins (such as ocratoxin and aflatoxin). These hazards, as shown in Table 4.14, have to be tested and controlled in every batch. The hazard in cooking and drying processes is controlling the survival and growth of microorganisms inefficiently. Metal contamination is a major hazard during grinding and sieving since these processes are mechanic. Results obtained from hazard analysis give a sign chedul magnitude of hazard in a next step, moreover, whether it is a CCP or not.

Significant hazards found in hazard analysis (Table 4.15) are used for determination of risk assessment by five class hazard score matrix which was given in Table 3.2. Mycotoxin content of bulgur is found to be 4th risk class (Table 4.15) by risk analysis after determining hazard analysis. Besides, cooking and drying processes are classified as 2nd risk class. Moreover, packaging process is classified as 3rd risk class While metal dedection and storage are classified as 2nd risk class.

Critical control points of Bulgur processing were determined. A decision tree (Figure 3.3) was used for determining steps which could be designated as critical control points Critical control points of Bulgur processing are listed on Table 4.15. After questioning, cooking, drying, and metal detection steps of bulgur processing are found to be in CCP structure. Significant hazards at those processes have to be followed by special monitoring systems.

Table 4. 14 Hazard and cause analysis for bulgur production

Process name/step	Process descriptions	Potential Hazards	Cause analysis*		Hazard Analysis(Y/N)**					
			Causes (Sources and reasons)	Cause class	Q1	Q2	Q3	Q4	Q5	SH
Raw Material Reception	Durum wheat (triticum durum) is received and analyzed foreign matter,insects,pesticide)	B: Insect, rats, pests,microorganisms	Agricultural environment,storage	R,E	Y	-	-	Y	Y	N
		C: pesticide residues,mycotoxins	Pesticides used in the growing of vegetables; Mycotoxins produced by microrganisms under undesirable storage and processing conditions.	R,E	Y	-	-	Y	N	Y
Cleaning	Foreing materials and broken kemels are separated by using separators	P: Foreign material	Insufficient cleaning	I,M	Y	-	-	N	-	N
Tempering	The milling process stars with the tempering of wheat in order to moisten the bran to enhance the separation of the bran from the endosperm and germ separation.(at room temperature for 12 to 48 h) Tempetering helps to uniform the water content of the wheat.	B: Survival of pathogens	The temperature and/or time of tempering and amount of water used	I,M	-	Y	Y	Y	Y	N
Cooking	Starch is gelatinized and kernel is almost cooked during processing.Enzymes and microorganism are also inactivated. (97 °C with 40 min)	B: Survival of pathogens	The temperature and/or time of cooking	I,M	-	Y	Y	Y	N	Y
Drying	The cooked kernels dried (about 14 h) in a tray drier at 55 °C to a moisture content of 10 % (wb)	B: Survival of microrganisms	The temperature and/or time of drying	I,M	-	Y	Y	Y	N	Y

Continue Tablo 4.14

Peeling	Removing of bran of wheat from endosperm part by using bran separators.	P: Metal contamination	Metals contaminate during peeling	M	-	Y	Y	Y	Y	N
Grinding and polishing	After peeling, bulgur is ground and polished	P: Metal contamination	Metals are contaminate during grinding and sieving	M	-	Y	Y	Y	Y	N
Sieving	Bulgur is sieved to reduce particle size	P: metal contamination	Metals are contaminated during grinding and sieving	M	-	Y	Y	Y	Y	N
Packaging	Classified bulgur is packed with suitable packing materials againts environmental agents	P: dirt, and foreing materials with packaging material	Recontamination by packaging material	M	Y	-	-	Y	N	Y
Metal detection	Detection of metal particles by metal detectors	P: Metal residue	Imroper metal detector	M	-	Y	Y	Y	N	Y
Storage	Packed bulgur is stored in dry and suitable places	B: Microbial growth	Inappropriate storage conditions	I,E	-	Y	Y	Y	N	Y

*Cause and effect analyses (Figure 3.2)

**Hazard analysıs –Questions(Figure 3.1)

Table 4.15 Hazard assesment and CCPs in the processing of bulgur

Process name step	Significant Hazard	Hazard assesment*			Preventive actions/control measures	CCP analysis (Y/N)**				
		Severity	Probability	Risk class		Q1	Q2	Q3	Q4	CCP no:
Raw Material Reception	C:Pesticides, mycotoxins	E	IV	4	Certified suppliers with HACCP program, mycotoxin analysis	Y	N	N	-	CP
Cooking	B: Survival of pathogens	B	II	2	Pathogens cannot be killed in following steps. Measurement parameters are temperature and time.	Y	Y	-	-	CCP1
Drying	B: Survival of microorganisms	B	II	2	Time-temperature profile.	Y	N	Y	N	CCP2
Packaging	P: Dirt, and foreing materials with packaging material	A	IV	3	Check if the cleaning chedule of the equıpment is correctly applied	Y	N	N	-	CP
Metal detection	P: Metal residue	A	II	2	Calibration	Y	N	Y	N	CCP3
Storage	B: Microbial growth	B	II	2	Good storage practices	Y	N	N	-	CP

*Hazard assesment (Table 3.2)

**CCP analysıs –Questions (Figure 3.3)

While operations make 83.3 % of taking raw material, operations take the measure for mycotoxin danger at the rate of 66.7 % in control measurements in which bulgur operations use important hazards as basis (Table 4.16). It is seen in the Table 4.19 that operations give importance to controlling at the rate of 72.2 % in cooking process and 61.1 % in drying process so as to avoid from Microbial hazard.

Table 4.16 Control measures and bulgur processing enterprises

Process name/step	Respondents		Significant Hazard	Preventive actions/control measures	Respondents	
	n	%			n	%
Raw Material Reception	15	83.3	C:Pesticidies, mycotoxins	Rapid test	12	66.7
Cooking	15	83.3	B:Survival of pathogens	Moisture content, temperature	13	72.2
Drying	15	83.3	B:Survival of m.o.	Moisture content, temperature	11	61.1
Packaging	12	66.7	P:Dirt and foreign materials with packaging material	GHP	4	22.2
Metal dedection	11	61.1	P:Metal residue	Calibration	5	27.7
Storage	6	33.3	B:Microbial growth	Moisture content, temperature	5	27.7

4.4.2.2. HACCP plan for bulgur processing

Critical limits for each critical control points for Bulgur processing were evaluated on Table 4.17. These were taken from literature, legal provisions, or from comparable standard procedures.

Aflatoxin analysis could be done by using rapid test kits for each batch. Packaging materials can be tested for each batch as well. Temperatures of cooking, cooling, and drying processes have to be monitored. Monitoring results should be continuously recorded. The problems revealed in raw materials and in Bulgur processing steps should be reprocessed and corrective actions processes have to be applied. Metal detector frequently has to calibrated and controlled for its accuracy (Table 4.17).

Table 4.17 HACCP plan for the processing of bulgur

CCP No:	Process name/step	Significant hazard	Critical limits	Monitoring			Corrective action
				Method	Frequency	Responsible	
CCP1	Cooking	B:Survivalof pathogens	No tolerance	Test kit	Each run	Operator	Check/repair the machine ,reprocess if necessary
CCP2	Drying	B:Survivalof microorganisms	No tolerance	Time/Temp., Moisture Content	Each run	Operator	Check/repair the machine ,reprocess if necessary
CCP3	Metal Detection	P: Metal residue	No tolerance	Metal dedection	Per month	Operator	Calibration

4.4.2.3. Quality control points of bulgur processing

Bulgur processing is not a long-chain process. However, physical processes are usually involved in bulgur processing. Quality parameters of bulgur processing in small scale plants are affected by technological and administrative applications. Quality parameters of bulgur processing and quality hazards in the process are given in Table 4.18. The key points about quality system of bulgur in the processing include: (1) how to avoid the browning reaction and maintain the good appearance of the product; (2) how to avoid the degradations and losses of biological activities ofbulgur to get the nutrient product; (3) how to get bulgur with long shelf life. Quality control points are determined by quality hazards [41, 42].

Quality control point (QCP) means a procedure where a control can be applied and a quality hazard (for example, taste, appearance, nutrition, color and so on) can be prevented, eliminated or reduced to acceptable levels. Raw materials reception, cooking, drying, peeling and sieving processes are analyzed as quality control points (Table 4.18).

Table 4.18 QCPs in the processing of bulgur

Process name/step	Quality Hazard	Preventive actions/control measures	QCP analysis (Y/N)*				
			Q1.	Q2.	Q3.	Q4.	QCP no:
Raw Material Reception	Foreign substances and grain seeds in wheat	Effective supplier assurance	Y	N	Y	N	QCP1
	Moisture content of wheat						
Cleaning	Foreign contaminants in water and air	Air filter, and water softening	Y	N	N	-	CP
Tempering	Moisture content	Time and temperature control	Y	N	N	-	CP
Cooking	Color and white spots	Time and temperature control	Y	N	Y	N	QCP2
Drying	Color and moisture content	Time and temperature control	Y	Y	-	-	QCP3
Peeling	Unpeeled grains	Adjusting tempering and milling process	Y	Y	-	-	QCP4
Grinding and polishing	Amount of broken/undersized grains	Adjusting operation conditions	Y	N	N	-	CP
Sieving	Amount of undersized/oversized grains	Adjusting operation conditions	Y	Y	-	-	QCP5
Packaging	Defective packaging	Adjusting operation conditions	Y	N	N	-	CP
Storage	Decreasing of the shelf life	Control of the storage conditions	Y	N	N	-	CP

*QCP analysis-Questions(Figure 3.4)

Other processes are determined as control points on quality parameters. Foreign materials in raw materials are removed in the sieving process. Meanwhile, defects on bulgur particles, directly affect quality, are however not able to be eliminated through the process. Color is an irreversible quality parameter during cooking and drying processes. Broken and defected wheat grains in the reception of raw materials should not exceed 1 % and have to be analyzed in every batch. Cooking and drying directly affect the final product color. Color of the bulgur is desired to be clear light yellow. Critical limits, monitoring and corrective actions of quality parameters determined through the QCPs are given in Table 4.19.

Table 4.19 Quality plan for the processing of bulgur

Process name/step	Quality control points	Quality parameter/hazard	Quality parameter/limits	Monitoring			Corrective action
				Method	Frequency	Responsible	
Raw Material Reception	QCP1	Foreign substances and grain seeds in wheat, moisture content of wheat	1 %(max) foreign substances , 14 %(max.) moisture content	Percent foreign substances content,moisture content	Each Run	Operator	Reject
Cooking	QCP2	Color and white spots	Amber color, 1 % (max)	Colorimeter	Each Run	Operator	Reject
Drying	QCP3	Color and moisture content	Amber color, 10-12 % moisture content	Colorimeter	Each Run	Operator	Reprocess if necessary
Peeling	QCP4	Unpeeled grains	No tolerance		Each Run	Operator	Reprocess if necessary
Sieving	QCP5	Amount of undersized/ oversized grains	Customer requirement, classifications	Sieving analysis	Each Run	Operator	Reprocess if necessary

4.4.3. Red Pepper Processing

4.4.3.1. Hazard analysis of red pepper processing

Hazard analysis begins with identification of food safety hazards associated with the raw material, and establishment of a priority list that is given in Table 4.20. First, a complete list of hazards that could potentially be of concern is drawn up. Cause analysis is based on determine potential hazard sources and classifying the causes [39]. This classification is done by fish bone diagram (Figure 3.2) and results are used in Table 4.20. Then, to identify significant hazards, a number of questions given in Table 4.20 have to be answered for each hazard that could be of concern at each red pepper production step [36]. Hazard analysis starts questioning of the presence of a potential hazard whether in raw material or in the processing step. Questioning determines the hazards whether it is significant or not. Questions and questioning results are shown in Table 4.20.

Table 4.20 according to one of the main hazards comes from properties of raw material. Raw material may contain pesticides and mycotoxins (such as ocratoxin and aflatoxin). These hazards, as shown in Table 4.20, have to be tested and controlled in every batch. The hazard in drying and storage processes is controlling the survival and growth of microorganisms inefficiently. Metal contamination is a major hazard during milling and sieving since these processes are mechanic. Results obtained from hazard analysis give a sign for the magnitude of hazard in a next step, moreover, whether it is a CCP or not.

Significant hazards found in hazard analysis (Table 4.21) are used for determination of hazard assessment by five class hazard score matrix which was given in Table 3.2. Mycotoxin content of red pepper is found to be 4th risk class (Table 4.21) by risk analysis after determining hazard analysis. Besides, drying and storage processes are classified as 4th risk class. Moreover, milling, siewing and packaging process are classified as 2nd risk class.

Critical control points are location, operation, procedure, or process where control can be carried out to remove the hazards for food safety or to reduce them to an acceptable level. Critical control points of red pepper processing were determined. Critical control points of red pepper processing are listed on Table 4.21. After questioning, raw material reception, drying, milling, siewing and packaging steps of red pepper processing are found to be in CCP structure. Significant hazards at those processes have to be followed by special monitoring systems.

Table 4.20 Hazard and cause analysis for red pepper production

Process name/step	Process descriptions	Potential Hazards	Cause analysis*		Hazard Analysis (Y/N)**					
			Causes (Sources and reasons)	Cause class	Q1	Q2	Q3	Q4	Q5	SH
Raw material reception	Red pepper is receptioned and analyzed	B:Mold,insects	Agricultural environment,	E,R	Y	_	_	Y	N	Y
		C:Pesticide,hormone aflatoxin	Aflatoxin produced by mold ,pesticides used in the growing of red pepper	R	Y	_	_	Y	N	Y
		P:Foreign material	Insufficent harvesting	R	Y			Y	Y	
Washing	Wet cleaning	B:Mold growth	Insufficent washing		_	Y	Y	N		
		C:Aflatoxin		I	_	Y	Y	N		
Seed seperation	Seed removal	B:Mold growth	Insufficent labor	I	_	Y	Y	N		
		P:Foreign material		M	_	Y	Y	N		
Belt conveying	Faul fruits seperation by belt conveying	B:Mold growth	Insufficent labor	I	_	Y	Y	N		
		C:Aflatoxin			_	Y	Y	N		
		P:Foreign material		P	_	Y	Y	N		
Cutting in to parts	Cutting fruits by knife	B:Mold growth	Insufficient cutting	I	_	Y	Y	N		
		C:Aflatoxin			_	Y	Y	N		
		P:Foreign material			_	Y	Y	N		

Continue Table 4.20

Drying	Mechanical or sun drying	B:Mold growth	The temperature and/or time of drying	I		Y	Y	Y	N	Y
		C:Survival of m.0.		M	–	Y	Y	Y	N	Y
		P:Soil or metal		E	–	Y	Y	Y	N	Y
Cooling	Outdoors or mechanical cooling	C:Mold growth P:Soil or metal	Environmental contamination during cooling	I	–	Y	Y	N		
				M	–	Y	Y	N		
Storage	Dried red pepper is in dry and suitable places	B:Mold growth	İnappropriate storage conditions	I	–	Y	Y	Y	N	Y
		C:Aflatoxin ,ınsects		E	–	Y	Y	Y	N	Y
Milling	Miiling of red pepper	P:Metal contamination and miiling device	Metals are contaminiate during milling	I	_	Y	Y	Y	N	Y
Sieving	After milling,is siewing of red pepper	P:Metal residue	Metal contaminiated during sieving	I	_	Y	Y	Y	N	Y
Packaging	Packing materials aganist enviromental agents	P:Dirt and foreign material packaging material	Recontaminated by packaging material	R	_	Y	Y	Y	N	Y

*Cause and effect analyses (Figure 3.2)

** Hazard analysis-Questions (Figure 3.1) [36]

Table 4.21 Hazard assessment and CCPs in the processing of red pepper

Process name/step	Significant Hazard	Hazard assesment *			Preventive actions\control measures	CCP analysis(Y/N)**				
		Severity	Probability	Risk class		Q1	Q2	Q3	Q4	CCPno:
Raw material reception	B:Mold,insects C:Pesticide,hormone aflatoxin	E	V	4	Certificated suppliers with HACCP program Aflatoxin analysis	Y	N	Y	N	CCP1
Drying	B:Mold growth C:Survival of m.o.	E	V	4	Time - temperature profile	Y	N	Y	N	CCP2
Storage	B:Mold growth C:Aflatoxin	B	V	4	Good storage practices	Y	N	N		CP
Milling	P:Metal contamination and miiling device	A	III	2	Metal dedection	Y	N	Y	N	CCP3
Sieving	P:Metal residue	A	III	2	Metal dedection	Y	N	Y	N	CCP4
Packaging	P:Dirt and foreign material packaging material	A	III	2	Control of the cleaning schedule is correctly applied at the equipment	Y	N	Y	N	CCP5

* Hazard assessment (Table 3.2)
** CCP analysis-Questions(Figure 3.3) [32]

While operations make 40 % of taking raw material, operations take the measure for mycotoxin danger at the rate of 40 % in control measurements in which red-pepper operations use important hazards as basis (Table 4.22). Drying in the sun is in demand among operations and its rate is 40 % , and mechanical drying is in lower demand and its rate is 20 % so as to avoid from microbial hazard. It is understood from Table 4.22 that while operations do not any control measurement in milling and sieving analysis, control programs are cared at the rate of 40 % in aflatoxin test and packaging units.

Table 4.22 Control measures and red pepper processing enterprises

Process name/step	Respondents		Significant Hazard	Preventive actions/control measures/prerequisite programs	Respondents	
	n	%			n	%
Raw Material Reception	2	40	B: Mold, insects		2	40
			C:Aflatoxin, pesticide residue		2	40
			P: Foreign material		2	40
Raw material storage	0	0	B: Mold growth	Moisture content and temperature	0	0
			C: Aflatoxin		0	0
Drying Mechanical	1	20	B: Mold growth	Moisture content and temperature	1	20
			C: Aflatoxin	Rapid test	1	20
Drying Sun	4	80	B: Mold growth	Moisture content and temperature	2	40
			C: Aflatoxin	Rapid test	2	40
Storage	5	100	B: Mold growth	Moisture content and temperature	1	20
			C: Aflatoxin		1	20
Milling	5	100	B: Mold growth	Moisture content	0	0
			P:Metal contamination and miiling device	Metel dedector	0	0
Sieving	5	100	P:Metal contamination and miiling device	Metel dedector	0	0
Aflatoxin test	2	40	C: Aflatoxin residue	Rapid test	2	40
Packaging	5	100	P: Dirt, and foreign materials with packaging material		2	40

4.4.3.2. HACCP plan for red pepper processing

What HACCP plan is centered on is food safety management and it is necessary for additional documentation to be kept to a minimum. Hazards, critical limits, monitoring, correcting and confirming processes with which it is possible to encounter during process in HACCP plan we have formed according to CCP in Table 4.21 is shown in Table 4.23 in red-pepper operations where we conduct our survey.

Critical limits are defined as criteria which are necessary for each corrector in CCP. Critical limits for each CCP for red-pepper production were shown in Table 4.26 by using references. Monitoring system is formed for the necessity of written document in confirming HACCP plan. It is possible to monitor through many physical and chemical method.

Aflatoxin analysis could be done by using rapid test kits for each batch. Packaging materials can be tested for each batch as well. Temperatures of drying processes have to be monitored. Monitoring results should be continuously recorded. The problems revealed in raw materials and in red pepper processing steps should be reprocessed and corrective actions processes have to be applied. Metal detector frequently has to calibrated and controlled for its accuracy (Table 4.23).

Table 4.23 HACCP plan for the processing of red pepper

CCP No:	Process name/step	Significant hazard	Critical limits	Monitoring			Corrective action
				Method	Frequency	Responsible	
CCP1	Raw Material Reception	B:Mold,insects C:Pesticide,hormonel test	No tolerance [43]	Test kit	Each party	Lab. technician	Rejection of doubtful lot
CCP2	Drying	B:Mold growth C:Survival of m.0.	No tolerance	Time/Temp., Moisture content	Each run	Operator	Check/repair the machine, reprocess if necessary
CCP3	Sieving	P:Metal residue	No tolerance	Metal dedection	Per month	Operator	Calibration
CCP4	Packaging	P:Dirt and foreign material packaging material	No tolerance	Visual control	Each party	Operator	Rejection of doubtful lot

4.4.3.3. Quality control points of red pepper processing

Quality parameters of red pepper processing in small scale plants are affected by technological and administrative applications. Quality parameters of red pepper processing and quality hazards in the process are given in Table 4.24. The key points about quality system of red pepper in the processing include: (1) maintain the good color of the product; (2) how to avoid the degradations and losses of biological activities of red pepper to get the nutrient product; (3) how to get red pepper with long shelf life. Quality control points are determined by quality hazards.

Quality control point (QCP) means a procedure where a control can be applied and a quality hazard (for example, taste, appearance, nutrition, color and so on) can be prevented, eliminated or reduced to acceptable levels. Raw materials reception, seed seperation, drying, milling and sieving processes are analyzed as quality control points (Table 4.24).

Other processes are determined as control points on quality parameters. Foreign materials in raw materials are removed in the sieving process. Color is an irreversible quality parameter during drying processes. Seed seperation and drying directly affect the final product color. Color of the first class red pepper is desired to be dark red. Critical limits, monitoring and corrective actions of quality parameters determined through the QCPs are given in Table 4.25.

Table 4.24 QCPs in the processing of red pepper

Process name/step	Quality Hazard	Preventive actions/control measures	QCP analysis (Y/N)*				
			Q1.	Q2.	Q3.	Q4.	QCP no:
Raw Material Reception	Foreign substances, color,mature,smell,taste Moisture content of red pepper	Effective supplier assurance	Y	N	Y	N	QCP1
Cleaning	Foreign contaminants in water and air	water softening and hijyenic	Y	N	N	_	CP
Seed seperation	Moisture content and amount of seed	Time and temperature	Y	Y	_	_	QCP2
Drying	Color and moisture content	Time and temperature control	Y	Y	_	_	QCP3
Storage	Decreasing of the shelf life	Control of the storage conditions	Y	N	N	_	CP
Milling	Unmilling part	Adjusting tempering and	Y	N	Y	N	QCP4
Siewing	Amount of undersized/oversized grains	Adjusting operation conditions	Y	Y	_	_	QCP5
Packaging	Defective packaging	Adjusting operation conditions	Y	N	N	-	CP
Storage	Decreasing of the shelf life	Control of the storage conditions	Y	N	N	_	CP

* QCP analysis-Questions(Figure3.4)

Table 4.25 Quality plan for the processing of red pepper

Process name/step	Quality control points	Quality parameter/hazard	Quality parameter limits	Monitoring			Corrective action
				Method	Frequency	Responsible	
Raw Material Reception	QCP1	Foreign substances, color,mature,in red pepper	0,30 %(max.m/m) foreign substances dark red [43]	Percent Foreign substances Content Moisture Content [43]	Each Run	Operator	Reject
		Moisture content of red pepper	Moisture content [43]				
Seed seperation	QCP2	Moisture content and amount of red pepper	No tolerance [43]	[43]	Each Run	Operator	Reject
Drying	QCP3	Color and moisture content	Dark red	Colorimeter, [43]	Each Run	Operator	reprocess if necessary
			10-15% Moisture content	Moisture content [38]			
Milling	QCP4	Unmilling parts	No tolerance [43]	[43]	Each Run	Operator	reprocess if necessary
Siewing	QCP5	Amount of undersized/oversized grains	Customer requirements, classifications	Sieving analysis [43]	Each Run	Operator	reprocess if necessary

CHAPTER V

CONCLUSION

The followings were concluded in the light of the observations made in this study:

- Pre-requisite programs for food safety practices in small-sized and middle-sized pistachio, bulgur and red-pepper operations have been analyzed.
- Problems in the process lasting from field to end of production in small-sized and medium-sized pistachio, bulgur and red-pepper operation have been identified.
- It has been observed that of the pre-requisite programs, carrying, storing and pest control practices are done at the highest level in these three production field.
- However, it has been understood that operations in these three fields do not have enough knowledge of sanitation, cleaning and preventing cross infection from pre-requisite programs
- HACCP plans have been formed by conducting analyses in pistachio, bulgur and red-pepper production fields.
- Control measurements that HACCP food safety systems need have been identified and have been compared with the practices in operations which completed questionnaires. It has been observed that measurements that are needed are not carried out in a high percentage.
- It has been understood that the applying percentage of pre-requisite programs are higher than that of HACCP plan.
- In the result of conducted survey, it has been understood via control activities which are done that practices of operations in quality systems are more effective than in those of food safety.

- However, it has been seen that quality management system certificates (ISO 9000) which firms have are fewer in number than food safety management system certificates (ISO 22000).

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APPENDICES

A.1 Questions of Survey

I. Corporate Structure of Accreditation

1. ISO 9000-Quality Management System
2. ISO 22000-Food Safety Management System (HACCP)
3. Turkish Standart Enstitue (TSE)
4. The others………………………………………

II. Production Technology

Pistachio	Control activities	The problems encountered
Raw material reception		
Cleaning		
Dehulling		
Floating		
Drying		
Splitting		
Splitting-home		
Splitting-factory		
Roasting		
Sieving		
Metal detector		
Packaging		
Product storage		

Bulgur	Control activities	The problems encountered
Raw Material Reception		
Cleaning		
Tempering		
Cooking		
Drying		
Peeling		
Grinding and polishing		
Sieving		
Packaging		
Metal detection		
Storage		

Dried Red Pepper	Control activities	The problems encountered
Raw material reception		
Washing		
Seed seperation		
Belt conveying		
Cutting in to parts		
Mechanic drying		
Sun drying		
Cooling		
Storage		
Milling		
Sieving		
Packaging		
Storage		

III.Pre-requisitePrograms

I. Buildings and auxiliary facilities associated structures, settlements	Y	N	Empty
1. Establishment of any environmental contamination (contamination) is not close to the field (eg, yeast production plants or cement factories around no)			
2. Made in a proper way, should be protected from dust and water flow in there.			
3. Contamination coming from outside the building, must be protected against pests.			
4. Roofs, walls and other structures of the organization, leaks (rain, mice, insects, .. to enter, etc.) have been made to prevent.			
5. Have wire mesh on the windows, flies, etc. is prevented entry			
6. To break window glass or glass-protected material made from outside.			
7. Doors with smooth surface, do not absorb liquid material can be self-closing and, if possible.			
8. Floor, liquids (clean water, ..) to loophole / grill can easily drain the slopes were made.			
9. Have wire mesh on the windows, flies, etc. is prevented entry			
10. To break window glass or glass-protected material made from outside.			
11. Doors with smooth surface, do not absorb liquid material can be self-closing and, if possible.			

II. Included in the study area and social area, the layout of buildings and extensions	Y	N	Empty
1. Areas of cross-contamination may be separated from one another in an appropriate manner (eg repositories of raw and finished products)			
2. Workflow in the enterprise from raw products to finished products in one direction. .			
3. If the business is possible within the process flow diagram			
4. Adequate lighting in an organization			
5. Lighting inside process does not change the color of the food .			
6. Light bulbs can be broken down into the protection of food.			
7. Steam, water condensationş or dust to perevent the accumulation provided accumulation provided adequate ventilation			
8. Ventilation filter inputs ; filters accordance with the cleaned/changed			
9. Disposing of sewage and other waste water expenses that loophole in the entries / filter / wire mesh there .			
10. Sewage and waste disposal costs in an organization and designed to prevent cross-contamination			
11. Food processing areas have enough hand-washing sink			
12. Where appropriate, hand washing by hand contact and to be either switched on or off without soap, disinfectant and hand towels for drying hands (single use), so there			
13. Hand wash in cold and hot water are sufficient			
14. Hand washing, eating and enough water goes in the upper room where there is change, and ventilation is provided			
15. Where appropriate "hand washing" was actually the instructions			
16. Toilet will not open directly to the food processing locations			
17. Easy to clean instruments used in the organization, non wearing made of material			
18. Equipment cleaning / disinfection supplies / equipment, food storage, processing and packing units is not..			
19. Water storage is required, suitable for storage of this work and contamination is prevented, off			
20. The water temperature and flow pressure cleaning, etc. for operation enough			
21. Employees' dressing rooms, toilets, do not open directly into the production and storage			
22. Employees' dressing rooms and toilets are cleaned on a regular basis: have clean records			
23. The location of the organization purchasing the goods, the different processes in place.			

24. Packing / storage and packing process in an isolated spot of: production of packaging dirty place, not so.			
25. There is no connection between the potable water and non-potable water			

III. Water, air, energy and other additional requirements to ensure	**Y**	**N**	**Empty**
1. In food processing "in the quality of drinking water" there.			
2. Water, drinking at regular intervals, are analyzed in terms of quality.			
3. The chemical treatment of water (eg chlorination) are tracked and recorded..			
4. Water storage is required, suitable for storage and contamination prevented this work, closed.			
5. Pressure, temperature and flow of water, cleaning, etc. are sufficient for operations.			
6. There is not any connection between Drinking and smoking the water			
7. Steam, water or dust concentration provided sufficient ventilation to prevent buildup.			
8. Input filter ventilation; filters are cleaned in accordance with / converting			

IV. Support services, including waste and sewerage systems	**Y**	**N**	**Empty**
1. Waste / refuse and stored materials are not edible, designed to prevent contamination.			
2. Waste / garbage containers marked used (waste is understood to be), does not have any leaks and off.			
3. Waste / garbage containers used to periodically cleaned / disinfected is (sanitation). Trash containers to allow pests to grow and not bad smell.			
4.In no way all of the food waste is processed, manufactured, packed or stored in areas not leave			
5.The rules for removal and storage of waste generated and designated responsible			
6.Waste is collected or stored in containers, preferably outside of the facility or, if the facility has been designed in the room does not exceed the temperature of +4 C.			
7.Somehow not enough space for proper removal of waste, equipment and housing facilities provided at the appropriate volume			

V. Compliance with the cleanliness of equipment, maintenance and preventive maintenance for the correct positioning	Y	N	Empty
1. The design and construction of equipment, it is expected to process			
2. The design and construction of equipment for cleaning, disinfection and maintenance to facilitate			
3. The design and construction of equipment, excessive concentration of water (condensation) to prevent			
4. All surfaces in contact with food, with smooth surface, wear-resistant, non-toxic, breaking, cracking, and frequent non vb'si cleaning / disinfectant made of suitable material			
5. Food contact surfaces with the coating material. Paint, used motor oil, etc. for food (food grade)			
6. Organization has an effective maintenance program (prevention), and maintenance records are kept			
7. The calibration of equipment and supplies are made and records are kept			

VI.Purchase of materials (eg raw materials, ingradiyentler, chemicals and ambalâjlama materials), as required (eg water, air, steam and ice), waste (garbage and sewage), the product of the control (storage and transport) management	Y	N	Empty
1. Transportation / containers used for packaging / materials in the pond, not wet			
2. Transportation / containers used for packaging / materials to the smell of food, chemicals, foreign matter (eg, nails, glass, wood, ..) can not pass. Food packaging materials for food contact (have permission from the relevant ministries)			
3. Coverage of food handling, filling, emptying to prevent contamination of food.			
4. The design of the food to empty the tank and to facilitate cleaning.			
5. Used to transport containers are cleaned periodically, have clean records.			
6. Manufacturers of food contact surfaces clean is testing			
7. Used for transport of containers or packaging materials hidden in insects, worms, etc. are being tested as to whether.			
8. Finished products, microbial, physical and chemical deterioration is moving to prevent			
9. Not used in the production area and wooden pallets in warehouses..			
10. Production site or broken pallets in warehouses, peeled, nail out (eg wooden boxes), so no carrying case			
11. Stored materials (food, packaging ,...) at least 30 cm away from the walls and stored in high places.			

12. Moisture-sensitive foods stored in the appropriate place. Dry and cool, dry food storage: temperature and relative humidity are monitored and recorded. Dry food should be kept in cold storage in the frozen product or not.			
13. Systematic stock rotation in the tank (FIFO). Rotation of stocks in warehouses and cleaning difficult and to facilitate the growth of insects do not have excessive accumulation.			
14. Or chemical contamination of food odors that may make equipment (eg cleaning-disinfection) in a different place from the food and packaging products are stored and labeled them..			
15. Packaging materials are stored in a clean place, not a tear at the top of protective packaging			

VII. Preventation from cross contamination	**Y**	**N**	**Empty**
1. Inappropriate in terms of food security due to non-compliance with the quality of the products, separation of processed products to be subjected			
2. Will cause cross-contamination of the personnel working in the business wear section, should be different from others			

VIII. Cleaning and sanitation	**Y**	**N**	**Empty**
1. Organization's written a cleaning / disinfection (sanitation) is the procedure.			
2. If you do some cleaning-disinfection procedure for subcontractors			

IX. Pest control	**Y**	**N**	**Empty**
1. Effective organizations have a written pest control program. (Pest of the reproduction, breeding and living conditions have been determined			
2. Of pest could enter the holes, openings and gaps are kept under control (windows, doors, fans or scratching at mosquito apparatus)			
3. In the fight against harmful biological control, cultural control, mechanical and chemical control methods determined struggle			

X. Personnel / personal hygiene	Y	N	Empty
1. Organization of training programs for employees with a written.			
2. Engage in contact with food hygiene training to all staff who work in jobs is given			
3. In accordance with the requirements of the production process is given the job training.			
4. Maintenance personnel responsible for food safety-related training is given.			
5. Staff is a disinfectant.			
6. Production workers in the field of hair off his feet in galoshes, gloves in the hands of people who come into contact with food, food for people who can sneeze into your			
7. Food processing to place non-smoking, gum chewing, eating forbidden			
8. All personnel entering the food processing instead of hours, or other jewelry that may fall into food materials (pens, etc.)			
9. Worn out clothes and other personal items, food processing is not over.			
10. Will enter from the outside instead of food processing to prevent contamination of people access on a controlled and wearing appropriate clothing.			
11. Transmit disease to people who work around the ban on food processing and carrier inspections are conducted periodically (see food regulation),			
12. In hand, open wounds, boils, etc., which people did not touch the food			

A.2. Anket Soruları

I. Kurumsal kimlik

Kurum adı	
Ürün çeşitliliği	
Mühendis/tekniker sayısı	
E-posta	
Telefon	
Ankete cevap veren kurum yetkilisi	

II. Kurumsal akreditasyon yapısı

1.ISO 9000-Kalite Yönetim Sistemi belgesi var
2.ISO 22000-Gıda Güvenliği Yönetim Sistemi (HACCP) belgesi var
3.TSE ürün belgesi var
4.Diğer (Üretim İzin Belgesi, BRC, IFS v.b……………………………………………)

III. Üretim teknolojileri

Kavrulmuş Çıtlak Fıstık	Kontrol etkinlikleri	Karşılaşılan problemler
Ham madde alımı		
Temizleme		
Kabuk soyma		
Fışlama		
Kurutma		
Çıtlak ayırma		
Çıtlatma-ev		
Çıtlatma-fabrika		
Kavurma		
Eleme		
Metal detektör		
Paketleme		
Ürün depolama		

Bulgur	Kontrol etkinlikleri	Karşılaşılan problemler
Ham madde alımı		
Temizleme		
Islatma		
Pişirme		
Kurutma		
Kabuk soyma		
Kırma		
Parlatma		
Eleme		
Paketleme		
Metal detektör		
Depolama		

Pul biber	Kontrol etkinlikleri	Karşılaşılan problemler
Ham madde alımı		
Yıkama		
Sap-tohum ayırma		
Taşıma bandı		
Parçalara bölme		
Mekanik Kurutma		
Güneşte kurutma		
Sogutma		
Depolama		
Öğütme		
Eleme		
Paketleme		
Depolama		

IV. Ön Gereksinim Programları

I. Binalar ve ilişkili yardımcı tesislerin yapıları, yerleşimleri,	**E**	**H**	**BOŞ**
1. Kuruluş herhangi bir çevresel bulaşma (kontaminasyon) alanına yakın değil (örn. çevrede maya üretim fabrikası ya da çimento fabrikası yok)			
2. Yolları uygun bir şekilde yapılmış, tozdan korunmalı ve su akış yeri var.			
3. Bina dışardan gelecek kontaminasyona, haşerelere karşı korunmalı.			
4. Çatı, duvarlar ve kuruluşun diğer yapıları, kaçakları (yağmur, fare, böcek,.. girmesi, vb) önleyecek şekilde yapılmış.			

5. Zemin, duvarlar ve tavan düz yüzeyli, kolay temizlenebilir ve üretime uygun şekilde yapılmış.			
6. Duvar, zemin ve tavanların birleşim yerleri yuvarlatılmış ve toz birikmesini önleyecek şekilde yapılmış.			
7. Duvar, zemin ve tavanların yapım malzemesi içeride üretilen gıdayı kontamine etmeyecek şekilde seçilmiş ve yüzeylerinde kırıklar, çatlaklar yok.			
8. Zemin, sıvıların (temizleme suyu,..) mazgallara/ızgaralara kolayca akabileceği şekilde eğimli yapılmış.			
9. Pencerelerde tel örgü var, sinek vb girişi önlenmiş			
10. Pencere camları kırılmaya karşı korumalı veya camın dışında malzemeden yapılmış.			
11. Kapılar düzgün yüzeyli, sıvı emmeyen malzemeden ve mümkmümkünse kendi kendine kapanabiliyor.			

II.	**Çalışma alanı ve sosyal alanlar dahil, bina ve eklentilerinin düzeni,**	**E**	**H**	**BOŞ**
1.	Çapraz kontaminasyon olabilecek alanlar birbirinden uygun bir şekilde ayrılmış (örneğin çiğ ve bitmiş ürün depoları)			
2.	Kuruluştaki iş akışı çiğ üründen bitmiş ürüne doğru tek yönde.			
3.	Mümkünse işletme içinde proses akış diyagramı var.			
4.	Kuruluş içinde aydınlatma yeterli			
5.	Işıklandırma içerde işlenen gıdanın rengini değiştirmiyor.			
6.	Işık ampulleri kırılarak gıda içine düşmeye karşı korunmuş.			
7.	Buhar, su yoğunlaşması veya tozun birikimini önleyecek şekilde yeterli havalandırma sağlanmış.			
8.	Havalandırma girişleri filtreli; filtreler uygun bir şekilde temizleniyor/değiştiriliyor.			
9.	Su giderleri ve diğer atıkların atıldığı kanalizasyon girişlerinde mazgal/süzgeç/tel örgü var.			
10.	Kuruluş içinde lağım giderleri ve atık giderleri çapraz kontaminasyonu önleyecek şekilde tasarlanmış.			
11.	Gıda işleme alanlarında yeterli sayıda el yıkama lavaboları var.			
12.	Uygun olduğunda, el yıkama yerleri elle temas edilmeden açılıp kapanacak şekilde ve sabun, el dezenfektanı ve el kurutmak için havlu (tek kullanımlık), vb var.			
13.	El yıkama yerlerinde yeterli soğuk ve sıcak su var.			
14.	El yıkama, yemek yeme ve üst değiştirme odalarında yeterli su gider yeri var ve havalandırması sağlanıyor.			
15.	Uygun yerlerde "el yıkama" talimatları asılmış.			
16.	Tuvaletler doğrudan gıda işleme yerlerine açılmıyor.			
17.	Kuruluş içinde kullanılan aletler kolay temizlenen, aşınmayan malzemeden yapılmış.			
18.	Ekipman temizleme/dezenfeksiyon malzemeleri/ekipmanları gıda depolama, işleme ve paketleme ünitelerinde değil.			
19.	Su depolama gerektiğinde, depo bu iş için uygun ve kontaminasyon önlenmiş, kapalı.			

20.	Suyun sıcaklık ve akış basıncı temizlik, vb operasyonlar için yeterli .			
21.	Çalışanların giyinme odaları, tuvaletleri, üretime ve depolara doğrudan açılmıyor.			
22.	Çalışanların giyinme odaları ve tuvaletleri düzenli olarak temizleniyor: temizlik kayıtları var.			
23.	Kuruluşa mal alımının yapıldığı yer, proses yerinden farklı.			
24.	Paketleme/ambalajlama yeri depolama ve proses yerinden izole edilmiş: üretim yerinde kirli ambalaj, vb yok.			
25.	İçilebilir ve içilemez su arasında herhangi bir bağlantı yok			

III. Su, hava, enerji ve diğer yan gereksinimlerin sağlanması,		E	H	BOŞ
1.	Gıda işleme yerinde "içme kalitesinde" su var.			
2.	Su, içme kalitesi açısından belirli aralıklarla analiz ediliyor.			
3.	Suya yapılan kimyasal işlem (örn. klorlama) izleniyor ve kayıt ediliyor.			
4.	Su depolama yerleri bulaşmalara karşı kapalı konumda			
5.	Suyun akışı ve sıcaklığı operasyonel işlemler için yeterli			
6.	Kirli ve temiz su karışmıyor			
7.	Buhar, su ve toz yogunluğunu önlemek için gerekli havalandırma sağlanmaktadır			
8.	Hava giriş filtreleri temizlige uygun			

IV. Atık ve kanalizasyon sistemi dahil destek hizmetleri		E	H	BOŞ
1.	Atık / çöp ve yenmeyecek malzeme depoları, kontaminasyonu önleyecek şekilde tasarlanmış.			
2.	Atık / çöp için kullanılan kaplar işaretlenmiş (çöp için kullanılacağı anlaşılıyor), herhangi bir kaçağı yok ve kapalı.			
3.	Atık/çöp için kullanılan kaplar belirli aralıklarla temizlenip/dezenfekte ediliyor (sanitasyon). Çöp kapları haşere büyümesine ve kötü kokulara olanak vermiyor.			
4.	Tüm atıklar hiçbir şekilde gıdanın işlendiği, üretildiği, ambalajlandığı veya depolandığı alanlarda bırakılmıyor			
5.	Atıkları uzaklaştırılması ve depolanması için kurallar oluşturulmuş ve sorumlular belirlenmiş			
6.	Atıkların toplandığı taşıyıcılar veya depolar tercihen tesisin dışında yada, tesisin içinde tasarlandı ise ;odaların sıcaklığı +4C'yi geçmemiş			
7.	Atıkların uygun birşekilde uzaklaştırılması için yeterli alan, uygun hacimde ekipman ve muhafaza imkanı sağlanmış			

V. Ekipmanların uygunluğu ile temizlik, bakım ve koruyucu bakım için doğru konumlandırılması	E	H	BOŞ
1. Ekipmanın tasarımı ve yapımı, ondan proses için beklenen Şekilde			
2. Ekipmanın tasarımı ve yapımı temizlik, dezenfeksiyon ve bakımım kolaylaştıracak şekilde			
3. Ekipmanın tasarım ve yapımı aşırı su yoğunlaşmasını (kondansasyonu) önleyecek şekilde			
4. Gıdayla temas eden bütün yüzeyler, düzgün satıhlı, aşınmaz, toksik olmayan, kırılma, çatlama, vb'si olmayan ve sık temizleme/dezenfeksiyona uygun malzemeden yapılmış			
5. Gıdayla temas eden yüzeylerin kaplama malzemesi. Boyası, kullanılan madeni yağ, vb gıdaya uygun (food grade)			
6. Kuruluşun etkili bir bakım programı var (önleyici) ve bakım kayıtları tutuluyor			
7. Ekipmanların ve teçhizatın kalibrasyonu yapılıyor ve kayıtları tutuluyor.			

VI. Satın alınan malzemelerin (örneğin hammaddeler, ingradiyentler, kimyasal maddeler ve ambalâjlama malzemeleri), yan gereksinimler (örneğin su, hava, buhar ve buz), atıklar (çöpler ve lağım), ürünlerin kontrolünün (depolama ve taşıma) yönetilmesi	E	H	BOŞ
1. Gıda taşıma / ambalajlama için kullanılan kaplar, bu iş için uygun.			
2. Taşıma / ambalajlama için kullanılan kaplarda / malzemelerde su birikintisi, ıslaklık yok.			
3. Taşıma /ambalajlama için kullanılan kaplardan / malzemeden gıdaya koku, kimyasal madde, yabancı madde (örn. çivi, cam, odun,..) geçmesi mümkün değil. Gıdaya temas eden ambalaj malzemesi gıdaya uygun (ilgili bakanlıktan izni var)			
4. Gıda taşıma kaplamın, doldurulması, boşaltılması gıdanın kontaminasyonunu önleyecek şekilde.			
5. Gıda tanklarının tasarımı boşaltmayı ve temizliği kolaylaştıracak Şekilde			
6. Taşıma için kullanılan kaplar periyodik olarak temizleniyor, temizlik kayıtları var.			
7. Üretici gıda ile temas eden yüzeylerin temizliğini test ediyor			
8. Taşıma için kullanılan kaplarda veya ambalaj materyalinin içinde gizlenmiş böcek, kurt, vb olup olmadığı test ediliyor.			
9. Bitmiş ürün, mikrobiyel, fiziksel ve kimyasal bozulmaları önleyecek şekilde taşınıyor			
10. Üretim sahasında ve depolarda tahta palet kullanılmıyor.			
11. Üretim sahası ya da depolarda kırık palet, soyulmuş, çivisi çıkmış (örn. tahta kasalar), vb taşıma kabı yok.			
12. Depodaki malzemeler (gıda, ambalajlama,...) duvarlardan enaz 30 cm uzakta ve yerden yüksekte depolanmış			

13. Neme hassas gıdalar uygun yerlerde depolanıyor. Kuru gıda depoları kuru ve serin: sıcaklık ve nispi nem izleniyor ve kayıt ediliyor. Kuru gıda deposunda soğukta saklanması gereken ya da donmuş ürün yok	
14. Depodaki stoğun rotasyonu sistematik (FIFO). Depolarda stok rotasyonunu ve temizliği zorlaştıracak ve haşere büyümesini kolaylaştıracak şekilde aşırı yığılma yok.	
15. Gıdalara koku ya da kimyasal bulaşma yapabilecek malzemeler (örn. temizlik-dezenfeksiyon) gıda ve ambalaj ürünlerinden farklı bir yerde depolanıyor ve üzerleri etiketli.	
16. Paketleme malzemeleri temiz bir yerde depolanıyor; üstündeki koruyucu ambalaj yırtık değil	

VII. Çapraz bulaşının önüne geçilmesi için önlemler	**E**	**H**	**BOŞ**
1. Gıda güvenliği açısından uygunsuz bulunan ürünlerin kalite uygunsuzlukları sebebi ile ,işlemeye tabi tutulacak ürünlerden Ayrılması			
2. Çapraz kirlenmeye neden olacak bölümlerde çalışan personelin iş kıyafetleri ,diğerlerinden farklı olmalı			

VIII. Temizlik ve sanitasyon	**E**	**H**	**BOŞ**
1. Kuruluşun yazılı bir temizleme/dezenfeksiyon (sanitasyon) prosedürü var.			
2. Eğer bazı temizlik-dezenfeksiyon işlemleri taşeron firmalara Yaptırılıyorsa			

IX. Haşere kontrolü,	**E**	**H**	**BOŞ**
1. Kuruluşun etkili ve yazılı bir haşere kontrol programı var. (Pestlerin üreme,çoğalma ve yaşama koşulları belirlenmiş			
2. Pestlerin girebileceği delik ,açıklık ve boşluklar kontrol altında tutuluyor(pencere,kapı,fanlarda sineklik veya cız aparatları)			
3. Zararlı mücadelede biyolojik mücadele,kültürel mücadele,mekanik mücadele ve kimyasal mücadele metotları belirlenmiş			

X. Personel / kişisel hijyen	**E**	**H**	**BOŞ**
1. Kuruluş, çalışanları için yazılı bir eğitim programına sahip.			
2. İşe girişte, gıdayla temas eden işlerde çalışacak bütün personele hijyen eğitimi veriliyor.			
3. Üretim proseslerinin gereksinimleri doğrultusunda da işbaşı eğitimi veriliyor.			
4. Bakımdan sorumlu personele gıda emniyetiyle ilgili eğitim veriliyor.			
5. Çalışanlar dezenfektan kullanıyor.			
6. Üretim alanındaki çalışanların saçları kapalı, ayaklarında galoş, gıdaya temas eden kişilerin ellerinde eldiven, gıdaya hapşırabilecek kişilerde ağız-burun maskesi, vb koruyucu var.			

7. Gıda işleme yerinde sigara içmek, sakız çiğnemek, yemek yemek yasak.
8. Gıda işleme yerine giren bütün personel saat, mücevher veya diğer gıdaya düşebilecek malzemeleri (kalem gibi) dışarda bırakıyor.
9. Dışarda giyilen kıyafetler ve diğer kişisel eşyalar, gıda işleme yerinde değil.
10. Dışardan gıda işleme yerine girecek kişilerin girişi kontaminasyonu önleyecek şekilde kontrollü ve üzerine uygun kıyafetler giyiyor.
11. Hastalık taşıyan kişilerin gıda işleme yerinde çalışması yasak ve portör muayeneleri periyodik olarak yapılıyor (bkz. gıda maddeleri tüzüğü).
12. Ellerinde açık yara, çıban, vb olan kişiler gıdaya temas etmiyor.

Table A.3 List of plants in alphabetic order

Pistachio Plants/Gaziantep	Bulgur Plants/Gaziantep	Dried Red Pepper Plants /K.maraş
Altın Fıstık Gıda Mad. San. Tic.Ltd.Şti.	Akın Bulgur Ve Gıda Mad. San.Ve Tic.Ltd.Şti.	Güneydoğu Tar. Satış Koop. Birliği
Asım Samlı Tar. Ürn. İth. İhr.ve Tic.A.Ş.	AS-BES Gıda San.Tic.Ltd.Şti.	Karayağlı Biber
Batallı Tarım Ürn. San.ve A.Ş.	Erkan Bulgur	Mabi Gıda Tar.
Cevahir Tic.	Çevik Bulgur	Memişoğlu Kırmızı Biber
Demirkardeşler Gıda San. ve Tic. Ltd.Şti.	Ergün Çik. Gof. Çik.Gıda San.Tic.Ltd.Şti.	Özköklü Biber
Emre Kardeşler	Erkan Bulgur	
Feramuz Gıda San. Ve Tic. Ltd. Şti.	Fincanlar Gıda San.Ve Tic.Ltd.Şti.	
Güneydoğu Tar. Satış Koop. Birliği	Gürbaşak Tar.Ürn.Ltd.Şti.	
Kahraman Tar. Ürn. Tic.S an. A. Ş.	Mis Bulgur Gıda A.Ş.	
Mehmet Kılıç Fıstık San.Ltd.Şti.	Nefis Bulgur San. Tic. Ltd. Şti.	
Kursan Gıda Paz. San.Tic.Ltd.Şti.	Özaslan Bulgur	
Ova Fıstıkçılık Gıda San. Tic. Ltd. Şti.	Özsarı Gıda San. ve Tic.Paz.Ltd.Şti.	
Öncel Fıstıkçılık Kuruyemiş Gıda San.	Pınar Bulgur Gıda San Ve Tic.	
Özdemir Ticaret	Sarıgüllük Gıda Tic. Ltd. Şti.	
Özgü Tarım	Özaslan Bulgur	
SGS Kuruyemiş	Tek Bulgur Gıda San. Tic.Ltd.Şti.	
Tekinalp Antep Fıs. San.Tic.	Tiryaki Agro Gıda San. Tic. A. Ş.	
Timur Yavuz	Yıldırım Tar. Ürn. Ltd. Şti.	
Tiryaki Agro		
Vitamin Gıda San. ve A.Ş.		
Yüceler Ticaret		