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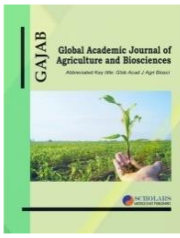

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Review Article

Inquiring Quality Assurance of the Table Olive Products

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Abstract: Table olives are the healthy fruit of the varieties of cultivated olive trees (*Olea europaea*), selected for the production of olives whose characteristics make them particularly suitable for processing. The processing of the olive is necessary, aiming mainly at the degradation of the phenolic glycoside oleuropein, a compound that gives a bitter taste to the fruit, making it impossible to consume immediately. Also, the various treatments aim to ensure the preservation of the product through the action of lactic acid bacteria (reducing the pH), to improve the quality of the final product (affecting the aroma, taste, texture, etc.). Olive varieties around the world are estimated to reach six hundred. Yet, there are three types of table olives in the market: natural black olives of the Greek type, black olives of California and green olives of the Spanish type. Table olive can be processed according to the method for natural black olives. Natural black olive is a natural product, i.e., the addition of chemicals is minimal. Its processing through the traditional method is simple and requires low energy consumption. The table olive processing plant must implement a healthy food production assurance system to protect the consumers from chemical hazards. This system is the HACCP (Hazard Analysis Critical Control Points) system, which is described by Codex Alimentarius. HACCP and ISO certification are a necessary step for most modern businesses, recognizing that a food business has developed, documented and implemented the right food production, standardization and packaging systems, according to these certifications.

Keywords: Table olives, quality assurance, HACCP, Codex Alimentarius.

INTRODUCTION

For thousands of years, olive oil and table olives have been staples of the Mediterranean diet. The two most important commercial types of table olives worldwide are Spanish-type green olives and Greek-type black olives [1]. The olive fruit essentially consists of the pericarp, or skin, the mesocarp, or pulp, and the endocarp, or pit, and the latter includes the seed. Table olives are made from healthy, specially cultivated, olive varieties that have been picked at the right stage of ripening and whose quality, after proper processing, corresponds to that of an edible well-preserved product. Table olives are known for their high nutritional value. They contain several nutrients, which largely depend on the variety of olive, the stage of ripening of the olive fruit, the growing conditions and the processing method [2]. The production of naturally black olives in brine, according to the Greek traditional method,

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is a simple natural method that does not use chemicals. This treatment includes the stages of acidification and fermentation, in which organic compounds such as sugars undergo biochemical changes by the action of microorganisms or enzymes producing acids, ethanol and carbon dioxide when placed in brine [3].

The quality of any food, therefore also of the table olive, is the composition of certain properties and quality characteristics. Food integrity and safety must be ensured through the identification and evaluation of all functional units of the process in order to avoid potential contamination and adulteration that could expose consumers to health risks. Quality assurance is a broad concept that focuses on the entire quality system, including suppliers and end consumers of the product or service [4]. It includes all activities aimed at producing high quality products and services. Quality control focuses on the production process and potential risks or errors. Certification with HACCP and ISO systems is a necessary action for most modern businesses, recognizing that a food business has developed, documented and implemented the correct food production, standardization and packaging systems in accordance with said certificates [4]. The HACCP system stands for Hazard Analysis Critical Control Points and is basically a tool for identifying and controlling food safety hazards, which hazards may occur in the context of food production and standardization [4].

The purpose of this work is to analyze the processing stages of the table olive with an emphasis on ensuring its quality, while a more extensive reference will be made to the chemical risks. Reference will be also made to the modern manners of processing, as well as to the quality assurance and quality control systems with an emphasis on preventing chemical risks.

GLOBAL PRODUCTION

Worldwide, it is estimated that there are almost 600 different olive varieties. Various characters have been used from time to time to distinguish the cultivated olive varieties. Today, for the best description, but mainly for the evaluation of the varieties, various characteristics are considered. From the distinction of different olive categories based on the size of the olive fruit, the following three categories emerge [5]: Large fruits (4.3-10.5 g.), medium fruits (2.7-4.2 g.) and small fruits (1.2-2.6 g.). Despite the abundance of olive groves on the world, the most quantity and high quality of olive oils still come from the Mediterranean. The complex nature of the olive is evident in the many varieties of olives that exist. Size, color and composition can distinguish a certain variety, but the ripeness of the olive plays an important role, as it affects both the taste and the oil produced. In addition, some olives are only suitable for eating and others are only suitable for olive oil production.

The composition of the olive fruit varies according to variety, region, year and stage of development. The average chemical composition of the olive fruit is:

- Moisture (60-70%) in the mesocarp and in the core (8-16% of the core's weight), which significantly determines the shape and condition of the fruit. The less moisture in the mesocarp, the higher its nutritional value. During its processing, moisture is reduced, depending on the commercial type, resulting in weight loss [6].
- Fatty substances (20-25%), the main one being oleic acid, which increases as the fruit ripens. During the fermentation of edible olives, no significant change is observed [7].
- Sugars such as glucose, fructose, mannose, galactose and sucrose [8]. Greek varieties are considered poor in fermentable components compared to their Spanish counterparts. Fermentable sugars perform at this stage of processing by developing the necessary microorganisms, but also during its maintenance.
- Proteins (1.5-3%), depending on the ripening stage and variety of the fruit. Despite their small proportion, olive proteins are remarkable, as amino acids participate in the structure of their molecules. Amino acids (glutamic acid, aspartic acid, valine, alanine, arginine, etc.) are nutritionally important, while at the same time they help the natural black olive to undergo a smooth process of acidolactic fermentation [9].
- Vitamins; the olive fruit is not considered a source of vitamins for human nutrition. However, it contains a certain number of vitamins (water-soluble and insoluble), such as ascorbic acid (Vitamin C), thiamine (Vitamin B1), riboflavin (Vitamin B2), niacin (Vitamin B6), carotene (Vitamin A) and tocopherols (Vitamin E, antioxidant) [10].
- Organic and inorganic components; the element that increases during processing is sodium, due to the addition of salt at the various stages.
- Phenolic substances (1-3%), whose role is varied in the organoleptic characteristics of the various types. They are discarded during the treatment with the washings and the addition of alkaline solution. The predominant phenolic compound found in the fresh olive is the bitter oleuropein. In addition, oleuropein inhibits lactic fermentation. Finally, its antimicrobial action is important [11]. There are many factors that can affect the phenolic components in table

olives, such as variety, degree of ripeness and, most importantly, the methods used to harden and process the table olives.
- Pigments (chlorophylls, carotenoids, anthocyanins, melanin); they change during the various stages of fruit development [12].

Olives are one of the most widely cultivated fruit crops in the world. In 2011, about 9.6 million hectares (24 million acres) were planted with olive trees, which is more than double the area of land devoted to apples, bananas or mangoes. Only coconuts and oil palms occupy more space [7]. The area under cultivation tripled from 2.6 to 7.95 million hectares (6.4 to 19.6 million acres) between 1960 and 1998 and peaked at 10 million hectares (25 million acres) in 2008. The 10 largest production countries, according to the Food and Agriculture Organization (FAO) are all located in the Mediterranean region and produce 95% of the world's olives. At the end of the 2020/2021 season, total European exports of table olives to markets outside the EU reached 320,810 tons, with a total value of €868 million (+8.6% and +4.6% respectively, compared to the previous growing season). During the same period, olive exports to EU countries amounted to 280,108 tons, with a total value of 704.8 million euros (+1.9% and +4.4% respectively, compared to the previous growing season).

Regarding the data for the production of the 2020-2021 growing season, they show 2,661,000 tons of table olives, a quantity that is 10.1% lower, compared to the previous year. Among the International Olive Council (IOC) member countries, Spain produced 20.5% of table olives worldwide, with a volume 19.3% higher than the previous year. Egypt produced 18.8% of the total, which is 23.1% less than it produced in the 2019-2020 growing season. Estimates for the 2021-2022 crop year show a 7% increase, with production reaching 2,846,500 tons. Consumption is expected to increase by 1.2%, compared to the 2020-2021 crop year. In the 2020-2021 growing season (September 2020 - August 2021), imports increased by 23% in Australia and Canada, 9% in the US and 4% in Brazil, compared to the same period of the previous growing year. In 2020-2021, intra-EU purchases decreased by 4% and non-EU imports increased by 12%, compared to the same period of the previous growing season. Greek-type black natural olives account for approximately 30% of the world production of table olives [7].

PROCESSING METHODS

The processing of the olive is essential, aiming mainly at the degradation of the phenolic glycoside oleuropein, a compound that gives a bitter taste to the fruit, making it impossible to eat immediately. Also, the various treatments aim to ensure the preservation of the product through the action of lactic bacteria (reducing the pH) and to improve the quality of the final product (affecting the aroma, taste, texture, etc.). There are three types of commercial table olives: natural Greek-type black olives, such as the Kalamon olive, California black olives, and Spanish-type green olives. The Greek Kalamon olive is processed according to the method for natural black olives. The table olive is a traditional fermentation product that must have certain morphological and technological characteristics such as:
- The flesh-to-core ratio should be as large as possible.
- The oil content should be small, so that there are no problems with the texture and the possibility of rancidity.
- Easy processing (immediate debittering, and removal of the core from the flesh).
- Thin and durable skin that facilitates processing.
- High content of fermentable ingredients (sugars).
- Cohesive flesh, uniform and appropriate size [10].

Varieties that have a large fruit (*mega-fruited*) usually have a moderate taste, but a high commercial value. Medium-sized varieties (*medium-fruited*) are more palatable and have significant commercial value if they have enough flesh, i.e. a large flesh-to-core ratio. In this category of table olives, we can add one more factor and classify the fresh fruit into one of the following species, depending on the degree of ripeness [13]:
- *Green olives*: The fruits harvested during the ripening period, before coloring and when they have reached a normal size. After processing, the green color of the olive can vary from green to straw yellow.
- *Color-changing olives*: Fruits harvested before the stage of full ripening, when the color changes. After processing, this type of olive can vary from pink to wine rose or brown.
- *Black olives*: The fruits are harvested when they are fully ripe or just before they are fully ripe. Once processed, black olives can range from reddish black to violet black, deep violet, greenish black, or deep chestnut-brown.

For thousands of years, olives have been an important food, possibly essential, for the inhabitants living around the Mediterranean basin and in the Middle East. Processing methods are diverse and include not only traditional ones, but also those derived from them and improved by new technologies. The bitterness of olives can be removed by alkaline treatment, by soaking in liquid to dilute the bitter compound oleuropein, or by biological processes. The product obtained in this way can be preserved in brine (depending on its specific characteristics), in dry salt, in a modified atmosphere, with heat treatment, with preservatives or with acidifying agents. In general, the full name includes information on the type of raw material, the process used to remove bitterness, and the product preservation method [13]. Olives can be subjected to the following commercial preparations [7]:

a) *Processed olives*: Green olives, olives of non-constant color or black olives that have undergone an alkaline treatment, then packed in brine in which they undergo full or partial fermentation and preserved or not by the addition of acidic agents:
1. Processed green olives in brine; examples are Spanish-type green olives, the "Picholine" type and the "Castelvetrano" one.
2. Processed olives that take color in brine.
3. Processed black olives; the bitterness of processed olives is removed by alkaline treatment.

b) *Natural olives*: Green olives, olives of non-constant color or black olives placed directly in brine, in which they undergo full or partial fermentation, preserved or not with the addition of acidic agents:
1. Natural green olives.
2. Natural color of olives.
3. Natural black olives; the bitterness of natural olives is mainly removed by dilution.

c) *Dehydrated olives and/or shrunken olives*: Green olives, olives with unstable color or black olives that have undergone mild alkaline treatment or not, preserved in brine or partially dehydrated in dry salt and/or by heating or by any other technological procedure:
1. Green olives dehydrated and/or shriveled.
2. Dehydrated and/or shriveled olives with unstable color.
3. Black olives dehydrated and/or shriveled; black olives in dry salt are a prime example of this preparation.

d) *Dark colored olives by oxidation*: Green olives or olives of unstable color preserved in brine, fermented or not, dark colored by oxidation in an alkaline medium and preserved in tightly sealed containers subjected to heat sterilization; these should be of a uniform black color.
1) Black olives; other names for these olives are canned ripe olives or California-type olives.

According to the IOOC (International Olive Oil Council) natural black ripe olives come from fruits that are fully ripe or before reaching full ripeness. It is the most important type of black olives that covers 30% of the trade and specifically the natural black olives in brine. They are characterized as raw placed directly in brine. Their taste is fruity and slightly bitter and they are preserved through natural fermentation in brine [14]. The olives intended for the specific commercial type are left on the tree until they enter the stage of full ripening and acquire a black-violet as a black color [10]. The product is soaked in brine, the concentration of which is kept constant at 8% to 10%, and the debittering takes place during fermentation without prior alkaline hydrolysis. The elimination of the bitter taste is due to the diffusion of a part of the phenolic compounds in the brine [7].

According to Panagou [15], the advantages, disadvantages and challenges for the natural black olive are as follows:
Advantages:
- The natural black olive is a natural product, meaning the addition of chemicals is minimal (water + salt + olives).
- Its processing is simple (traditional method).
- Requires low power consumption.

Disadvantages:
- The process is time-consuming (6-7 months).

Challenges:
- There are many challenges in the processing and commercialization of natural table olives to obtain a uniform color of the final product;
- To obtain pitted and sliced olives with a good texture;
- To speed up the debittering process;
- Exploiting the product, considering its nutritional characteristics and reducing salt levels;
- Optimization of the harvest stage;
- Minimization of spoilage disadvantages;
- And many more.

Fermentation is an important process, since it achieves the preservation of the product for a long period of time, without special requirements for preservation conditions. Fermentation of natural black olives can be either anaerobic or aerobic. The brine accelerates the transfer of water-soluble components (oleuropein, etc.) from the flesh to the brine, so the debittering of the fruit is achieved by the gradual hydrolysis of the oleuropein in the brine. At the same time, the extraction of the ingredients turns the brine into a nutrient substrate suitable for the growth of microorganisms [8]. More specifically, the olives are placed in brine with a NaCl concentration of 8-14% (w/v). At these concentrations, only lactic acid bacteria (LAB) grow, which are resistant to salt and are the predominant microflora in these fermentations. The high concentrations of NaCl in the brine ensure that spoilage of the final product, which is caused by bacteria, is avoided. A low concentration of NaCl in the brine allows the growth of proteolytic bacteria and the creation of an undesirable odor [8].

The LABs that grow during the spontaneous fermentation of natural black olives adapt more easily to the high concentrations of brine in NaCl, compared to the LABs of green olives [16]. About 75% of LABs isolated from black olives grow satisfactorily in 8% brine, but when the brine is 10% the growth of practically all LABs is inhibited. The salt content has a great influence on the solubilization of organic and inorganic components and the various chemical changes during fermentation. Polyphenol levels in olives increased the lower the brine salt content. The effect of salt on pH and acidity is due to its effect on the growth of LABs. Higher brine salt content results in relatively high pH (4.2-4.5) and low acidity. During the fermentation and the stay of the olives in the brine, the NaCl is transferred into the flesh of the olive and thus the strength of the brine is reduced. The balance between the brine and skin lasts long after the olives are placed in the brine, since the skin of naturally ripe olives maintains its selective permeability for some time [8].

In order to have the best fermentation rates, the temperature should be kept around 25 °C. Higher temperatures favor the diffusion of polyphenols from the flesh into the brine. This temperature, in relation to the sodium chloride concentration of the brine, ensures a qualitative and safe final product, the fermentation proceeds smoothly and the black olives have a good color, firm flesh and good taste. On the contrary, at high temperatures, many olives are affected by softening of the tissue, they have slits from aerobacteria and inside the sarcoma they have air pockets [7]. The final acidity of the brine in lactic acid, in a spontaneous fermentation of olives of this type, is usually lower than 0.5% and the pH ranges only at 4.3-4.5, due to the slow diffusion of sugars in the brine and the presence of oleuropein in it may not allow the complete fermentation of sugars by microorganisms [17]. However, if complete fermentation is achieved and the sugars have been exhausted due to their consumption by the microorganisms, the final acidity in lactic acid can reach as much as 0.8-1.0%. The factors that influence the course of fermentation are:

1. The pH of the brine (between 3.8 and 4.2).
2. The % of NaCl in the brine (concentration 6% to 8% w/v).
3. The temperature during fermentation.
4. The availability of nutrients and their diffusion through the skin of the fruit (sugars).
5. The composition of polyphenolic compounds in the fruit.
6. The ventilation of the containers.
7. The variety of the olive, especially regarding the natural olives.

QUALITY ASSURANCE

Quality assurance is a broad concept that focuses on the entire quality system, including suppliers and end consumers of the product or service. It includes all planned or systematic actions necessary to provide sufficient confidence that a product or service will satisfy specific needs [7]. Product quality, according to [18], includes:

- The quality characteristics of the product,
- Its reliability,
- Its stable properties,
- And the safety of human health.

Microbiological contamination in food and other types of chemical and physical contamination have led to increasing public interest in food quality and safety worldwide [19-22]. Pressure from consumers' concerns is significant for food organizations [23]. Regarding the safety and quality of the food sector [24], the food industry should be constantly alert due to competition. This has been demonstrated in recent years by the growing demand to provide quality food products and services to the table olive processing companies under study, due to competition and customer demands. The competitive environment that exists in the agri-food sector today is becoming hostile and unforgiving. The ever-increasing competition between varieties [21], combined with the increase in consumer education, has increased customer expectations for safer and better quality products [24].

In order to design products that will be accepted by customers, it is necessary to convert customer requirements into product specifications [7]. On the other hand, since competition between companies is constantly increasing and the quality of products offered is generally at the same level, parameters such as facilities, equipment, security and personal interaction of customers with company employees can be a differentiator. Quality in food processing industries occurs during the production and delivery of the product. Unlike service providers, food producers have the advantage that a factory acts as a buffer between production and consumption. However, external parameters such as facilities, equipment and personal interaction, as well as after-sales support, are similar between service companies. Parameters such as the above make it difficult, if not impossible, to detect and correct defects before delivery to customers. In addition, managers and employees influence the production and delivery situation of a safe and quality product [25]. This explains why managers consider the satisfaction of internal customers as important as that of external customers. Customer satisfaction is one of the main goals of any business. Customer satisfaction is studied as the difference between expectations and perceptions of products or services [19]. Studies done by Keiningham & Vavra [26] found that by increasing customer satisfaction by 1%, there is an average increase of 2.37% in return on investment.

Quality features

Quality of any food is the combination of certain properties or quality features, through which the degree of acceptance by the consumers public is determined. In general, quality assessment, quality control and food quality assurance are a special subject of food science and technology. It is of increasing interest to the consumers, industry and control services. The assessment or measurement of the quality characteristics of a food can be done either by the consumers, based on their subjective criteria (stimulation for certain sensory organs), or by using laboratory methods, where with instruments (balance, colorimeter, pH-meter, liquid-gas chromatography device, high-efficiency liquid chromatography device, etc.) physical, chemical and physicochemical measurements are carried out [27]. The sensory analysis based on a trained panel of experts is essential for the classification and quality control of table olives, but it is not always feasible due to high costs, it is time-consuming and often without any objective value. In recent decades, many efforts have been made to study the aromatic fraction of fermented olives, based mainly on chromatographic determinations. However, these analytical techniques are also time-consuming and require sophisticated equipment and skilled personnel. Therefore, it would be of great interest to investigate the possibility of a low-cost, rapid and non-destructive analytical procedure, such as electronose, to quantify the overall quality of table olives. In the last decade, electronic nose technology has offered practical exploitation [28]. The quality characteristics of the table olive can be distinguished according to [10]:

- The size of the core (micro-cored, mid-cored and macro-cored);
- The skin of the fruit (thin and elastic);
- The texture (consistency of the flesh);
- The taste and smell [28];
- The sugar content;
- The oil content;
- The defect (e.g., the presence of foreign matter such as insects, fungi and bacteria);
- The changes that olive undergoes during processing and the diseases it has contracted before its collection.

HACCP and ISO Systems

Food integrity and safety must be ensured through the identification and evaluation of all functional units of the process, in order to avoid potential contamination and adulteration that could expose consumers to health risks. According to the International Standard Organization (ISO), quality is the set of properties and characteristics of a product that give it the ability to meet the demands of the consumers. In this specific case, where this definition is applied to food, in addition to satisfying the consumers' requirements, the precaution of this should be also added. At this point, the quality parameters of a food can be examined, which are the following: appearance and organoleptic characteristics, nutritional value, legislation, production costs, adaptation to the new food profile. In addition to the above parameters of the quality of a food, there is another one, its safety, which is the most important parameter. Safety concerns the protection of the consumers by producing food that will not cause harm to their health. It is a moral and legal obligation of the manufacturer, but also of the public authorities and, of course, a demand of the consumers. The way in which the production of safe products can be ensured is the implementation of the HACCP system (Hazard Analysis Critical Control Points), which is complemented by the rules of good hygienic practice. It is therefore concluded that HACCP is essentially the main way to ensure the most important parameter of a food’s quality towards the consumers, its safety. Therefore, the purpose of the HACCP system is to prevent potential problems from occurring, to ensure food safety from harvest to consumption.

The table olive processing unit must implement a system to ensure the production of healthy food. This system is the HACCP system, which is described by Codex Alimentarius: Codex Guidelines for the Application of the HACCP system (CAC/GL 18-1993). Within the framework of this system, the parameters that help to remove or limit the risks of the products must be observed precisely at the critical control points, with observations, inspections or sampling. Also, to check whether the rules of good hygienic practice are observed, for the staff, cleanliness and disinfection of the space and equipment. The whole process is supervised by the managers of the production and quality assurance departments. The rules of good hygiene and industrial practice are integrated into the HACCP system, through the continuous training of the staff in these rules and with a control system that will ensure compliance with these parameters. These two elements, in turn, are part of a Quality Assurance System, which meets the requirements of ISO 9000 standards and leads to the production of safe, healthy, legal, tasty, easy-to-use, nutritious and stable quality products. Good manufacturing practice (GMP) and hygiene must cover requirements for the following:

- Industrial facilities;
- Processes of receipt of raw materials, processing, storage and distribution;
- Food hygiene and safety.

The implementation of the HACCP system in general, as described by Codex is not mandatory, as long as the company can develop a rudimentary system of quality assurance techniques, based on the principles of HACCP. The objectives of food law are to ensure product quality, public health, consumer safety, ensuring the free movement of goods and assigning primary responsibility in the event of a defective product. Thus, the development of flexible systems that are adapted to the particularities of each business is carried out, that can identify and assess the magnitude of the risks and furthermore prove that the necessary procedures for food safety have been implemented, recorded and reviewed. The assessment of potential food safety risks, critical control points and established control procedures is a new and important complement to the current official control techniques [29]. The seven principles of HACCP are:

1. Identification of Potential Risk Sources, which must be prevented, eliminated or reduced to acceptable levels.
2. Identification of the Critical Control Points in the stages, to prevent or reduce or even eliminate a Risk Source.
3. Determination of the Critical Limits at the individual Critical Control Points.
4. Defining effective Monitoring Procedures at Critical Control Points.
5. Determination of Corrective Measures, in case of detection of deviations from the Specified Critical Limits.
6. Defining procedures for keeping the effectiveness of points 1 to 5 above.
7. Preparation of documents, recording the control procedures, taking and dealing with measures mentioned in points 1 to 6 above.

Therefore, every company must have an integrated quality assurance system, based on the principles of the international standards of the HACCP system. For table olive standardization businesses, HACCP implementation is essential and non-implementation has legal penalties.

Chemical hazards

In 1995, the FAO/WHO defined as a hazard any biological, chemical or physical factor/property of a food, the consumption of which may have adverse effects on the health of the consumers. Chemical hazards [30] are chemical substances toxic to humans, the presence of which is completely prohibited or limited below specified limits. These substances come from:

- The use of agricultural drugs;
- The environment;
- The use of additives that do not meet the requirements of the Food and Beverage Code;
- Non-compliance with the rules of good hygienic practice, during the processing of food by the company's staff, with the result that there is a possibility that the food may be contaminated with detergents and disinfectants.

Based on the above, chemical risks are divided into two categories:

- In naturally occurring poisonous substances, which come from natural components of food and not from environmental, industrial or agricultural contamination. These hazards include a variety of chemicals of plant, animal and microbial origin.
- To the additional poisonous substances, which are added to food at any of its production stages, such as its cultivation, harvesting, processing, storage and distribution. The addition may or may not be intentional. Known substances of this kind are pesticides, fertilizers, the various cleaners used, food preservatives and antibiotics [7].

There are prerequisites in relation to chemical hazards [30]. Within the framework of the food processing system, the parameters that help to remove or limit the risks of the products must be observed precisely at the critical control points, with observations, inspections or sampling. Also, to check whether the rules of good hygienic practice are observed, for the staff, cleanliness and disinfection of the space and equipment. The construction materials of the equipment, equipment parts and utensils that come into contact with food must meet the conditions of the relevant legislation. Also, they must be suitable for the purpose for which they will be used, they must not transmit color, odors or taste in food, not to transfer toxic substances to food, not to corrode, oxidize, crack, break, peel, deform and decompose, to have a smooth and non-absorbent surface, to be washed and disinfected easily and effectively. For the cleaning and disinfection of the equipment and the building, a personnel manager should be appointed, who will implement a cleaning and disinfection program, which, especially for processing areas, should require daily cleaning, after the end of the work. He/she should keep a record of cleaning and disinfection, with detergents and disinfectants that are suitable and with clear instructions for their use and application. Especially for the filters of the artificial ventilation systems, these must be cleaned regularly, and if there are bacteriological filters, they must be checked for their effectiveness, being cleaned and sterilized regularly. The fight against rodents and insects must be based on an integrated system of disinfection and myocide, by a special disinfection company, which applies the system correctly, efficiently and based on the legislation governing the fight against insects and rodents [30]. Raw and auxiliary materials, as well as packaging materials, must be kept in clean areas in which the disinfection and myocide program is in force.

Failure study

In the failure study, a table is used, in which elements such as, the component or the function, in this case the stage of the process that shows the failure problem, the possible mode of failure, i.e., in which way the failure occurred, the effects of the failure, i.e., the possible results that will happen from the occurrence of the failure, such as production delay and defective products. Also, it contains the possible causes of the failure and the existing controls applied by the company to detect or prevent the specific failure [18]. Then, there are the recommended actions to reduce the chance of the failure occurring. During the processing stages of the table olive, as for example is the case of the Kalamon natural black olive (Greek type), in terms of chemical risks and the possibility of their occurrence, but mainly also the actions proposed to reduce the possibility of failure, as it follows from the corresponding study [18], the failure can only appear at the initial stage of processing by unqualified personnel.

CONCLUSION

The processing of the natural black olive has the possibility of failure from a chemical hazard only at the initial processing stage and from an error of unskilled personnel, such as the time the product remains at a certain stage or insufficient disinfection of premises and equipment. In the remaining stages of production, some critical control points can be identified in both Greek and Spanish type olives. Especially the Kalamon variety olive, by treating it in brine without the use of NaOH, as in other treatments, ensures a lower chance of failure from chemical hazards.

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