The implementation of a new ISO 22000 in the Cyprus olive oil industry

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Abstract

Quality and safety are important for the delicatessen industries. The quality assurance of the whole process is significant for consumer acceptability, while the assurance of safety is obligatory for the protection of public health. Quality is required in order for the product to meet the customers' specifications and may be assured by application of a quality management system such as ISO 9001. As far as food safety is concerned, E.C. food legislation, recognizing the significance of the safety for human health, has established the application of 852/2004 in which the basic hygiene and HACCP requirements are defined. Implementation of the HACCP system is a fundamental approach to ensure the safety of the food supply, providing a systematic procedure for the identification, evaluation and control of hazards in each operation. Risk profiling is one activity in preliminary risk management that has recently been defined as a description of a food safety problem and its context developed for the purpose of identifying those elements of a hazard or risk that are relevant to risk management decisions. In Cyprus food plants have started to apply safety programs in the past few years in a preliminary way to comply with the food safety legislation and regulations (852/2004/EU, 854/2004/EU). This paper describes the application of the above according to the new standard ISO 22000:2005 in an olive oil (olive oil production line) industry in Cyprus.
Keywords: ISO 22000, food safety, quality assurance, olive oil.

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1 Introduction

Food hygiene is defined by *Codex Alimentarius* as 'all conditions and measures necessary to ensure the safety and suitability of food in all stages of food chain' [1]. The HACCP (hazard analysis critical control point) system is compulsory in EU member states for safety assurance based on hazard analysis while prerequisite hygiene programs (GHPs: Good Hygiene Practices, GMPs: Good Manufacturing Practices) are necessary to support the system [2]. Methods to conduct a hazard analysis [3] and establish critical control points using risk assessment and food borne outbreak evaluations [4] have more recently been supported by elaboration of the risk profiling approach. HACCP is a highly specialized system for food safety that is needed for carrying out an analytical study of microbiological, chemical and physical hazards. Hazard analysis contains the identifications of potential hazards throughout the food process and the identification of critical stages (CCPs) that must be controlled in order to assure the food safety [2,5,6]. Quality and safety are important for the delicatessen industries. The quality assurance of the whole process is significant for consumer acceptability, while the assurance of the safety is obligatory for the protection of public health. Quality is required in order for the product to meet the customers' specifications and may be assured by the application of a quality management system such as ISO 9001. As far as food safety is concerned, E.C. food legislation, recognizing the significance of the safety for human health, has established the application of 852/2004 & 93/43 in which the basic hygiene and HACCP requirements are defined. Implementation of the HACCP system is a fundamental approach to ensure the safety of the food supply, providing a systematic procedure for the identification, evaluation and control of hazards in each operation. Small business may lack the in house knowledge and resources for the correct implement of HACCP. Before implanting a HACCP system, a food business should already have in place various practices that may be collectively termed prerequisite programs (PRPs) (e.g. raw materials specifications, staff training, hygienically designed facilities and good hygienic practice (GHP) [8].

Risk profiling is one activity in preliminary risk management that has recently been defined as a description of a food safety problem and its context developed for the purpose of identifying those elements of a hazard or risk that are relevant to risk management decisions [9]. Risk profiling involves the systematic collection of information needed to make a decision on what will be done next and which resources should be allocated to more detailed scientific assessment. The risk profiling process typically provides information on: the hazard, exposure to the hazard, adverse health effects, public health surveillance information, control measures, and other information relevant to risk management decision-making.

According to the HACCP principles, in each stage of the food process, all possible hazards (physical, chemical, microbiological) are identified, their importance is evaluated and all the preventive measures for their control are described (principle 1). The Critical Control Point (CCPs) should be identified

using a risk assessment according to ISO 22000:2005 where control is critical for controlling the safety of the product (principle 2). For each identified CCP critical limits for preventing measures (principle 3) and monitoring systems (principle 4) are established. When monitoring shows that a critical limit has not been met, corrective actions must be taken (principle 5). Finally, procedures to verify that the system is working properly (principle 6) and effective records to document the HACCP system are established (principle 7), [2,5].

In Cyprus there are more than 30 olive oil industries that are produced olive oil. In Cyprus foods plants have started to apply safety programs in the past few years in a preliminary way to comply with the food safety legislation and regulations (852/2004/EU, 854/2004/EU). The verification activities in plants encompass sampling for monitoring CCPs and determination of microbiological parameters, GHPs-GMPs measurements, review of records, flow diagrams and the HACCP plan amongst others. However, for the implementation of such a safety assurance system, hygienic programs like GHPs-GMPs are also required.

2 Material and methods

Olive oil is produced following the general flow diagram (Figure 1). This represents the typical production of a delicatessen based on both the bibliography (Metaxopoulos et al [11]) and the suggestions of the industry's expertise. The processing steps differentiate depending on the product.

In each stage of the process, the first two principles are developed. Thus all possible hazards (physical, chemical, microbiological) are identified, and the preventive measures are described and the CCPs are identified using a risk assessment according to ISO 22000:2005 (Tables 1–3). In particular, a risk assessment by risk levels taking in account both the possibility of appearance and the severity of the danger is used. Following this, as the rest of the principles require, for each identified CCP critical limits for preventing measures and monitoring systems are proposed, as well as corrective actions. Based on these data, procedures to verify and effective records to document the HACCP system can be established. Also, the prerequisites measures related to GMPs - GHPs in each production step are described.

3 Results and discussion

Olive oil is very common to the culture of Cyprus and to Mediterranean recipes (especially in Cyprus, Greece, and Italy). The identification of CCPs and the required actions for their control are crucial for the appropriate HACCP development. However, nowadays risk assessment and the quantification of hazards are recommended focusing on the consumer's health and a higher safety level is proposed. In order to identify the CCPs the methods used are presented in Tables 1–4. Table 1 presents the possibility of the appearance of a negative impact on public health (SEVERITY-S) using grades 0-3. Table 2 presents the possibility of the appearance of the specific danger (PROAPILITY-P) using grades 0-2. Table 3 presents the Risk Level where the Risk Level=R=S + P,

using scale 0-2 for probability and scale 0-3 for the severity. Table 4 presents the Definitions of Risk Level using levels 0-5. Table 5 presents the risk assessment result of the flow chart (figure 1).

According to ISO 22000:2005 all food safety hazards that are reasonably expected to occur in relation to the type of product, type of process and actual processing facilities should be identified and recorded. The identification based:

Table 1: The possibility of the appearance of negative impact on public health (SEVERITY-S).

Grade	Definition
0	No damage or human ill. No legal requirement.
1	Low concentration of microbiology activities in the food, which is under the limits. No serious illness of the consumer. No legal requirement. All the parameters, microbiological and chemical, are under the limits of all the directives or legislations. The physical danger can be controlled.
2	The product can be characterised as degrading (high concentration of microorganisms and the product is of low quality). If the product proceeds to the consumer it may affect a selected population among adults and children. Risk of mild food poison. The product is better removed from the market. May have a legal claim.
3	The product is not acceptable. All the parameters are over the limits. If the product is ingested the consumer may be in danger. We have a serious food poisoning risk. We have a legal claim. The product must be removed immediately from the market.

Table 2: The possibility of the appearance of the specific danger (PROAPILITY -P).

Grade	Definition
0	Low possibility of appearance
1	Possible appearance
2	High possibility of appearance

Table 3: Risk level estimator [RISK = SEVERITY + PROBALITY].

	Severity			
Probability	0	1	2	3
0	0	1	2	3
1	1	2	3	4
2	2	3	4	5

Table 4: Definitions of risk level.

Risk Level	Definition	Required control action
0	Uncreated	Very low danger. Typical preventative actions.
1	Very Low	The danger is accepted by the company and is under the limits of legislation. The acknowledged danger appears to be problematic only in selected members of the population (such as a person with a heart problem or diabetes).
2	Low	Danger that requires more checks and control (an optical check is accepted). The acknowledged danger appears to be problematic only in selected members of the population. The HACCP plan may needs changes. If the corrective actions are repeated more than 30% in the same procedure and in the same year then there must be a CCP. All the parameters are under the limits and the product is safe.
3	Fair	Danger that is not acceptable. However the uncontrolled danger does not show any problems to public health. It shows problems only in selective people (such as a person with a heart problem or diabetes). Also, the product can characterised as degrading. If the corrective actions are repeated more than 10% in the same year then it must be a CCP. The HACCP plan must be re-checked. The product needs laboratory checks and then proceeds with corrective actions in order that the procedures return to safe limits. There is a possibility of having food poisoning (with transiently symptoms). If the product is in the market it must be traced back.
4	High	This is a CCP. The danger is not acceptable and if it is outside of the limits will cause problems to the consumer. The product can be characterised as degrading to dangerous for human health. If the corrective actions are repeated more than 5% in the same point or procedure in the total corrective actions in the same year then it must be a CCP. The HACCP plan must be re-checked. The product needs laboratory checks and then proceeds with corrective actions in order that the procedures are returned in safe limits. The HACCP Team must be notified and then all the procedures must be stopped. Corrective actions must be taken while the product must be removed from the market.

Table 4: Continued.

5	Very High	CCP. The entire recognized dangers are not acceptable. The product is characterised as unacceptable and very dangerous if it is out of limits. Significant problems for human health. If the corrective actions are repeated more than 5% in the same year then it must be a CCP. The HACCP plan must be re-checked. The product needs laboratory checks and then proceeds with corrective actions in order that the procedures are returned to safe limits. The HACCP team must be notified and then all the procedures must be stopped. The HACCP team must take corrective action while the product must be removed immediately from the market.

- ✓ On experience
- ✓ On external information from, to the extent possible, epidemiological and other historical data
- ✓ On the preliminary information data collected according to the food safety team, the product characteristics (biological, chemical, physical), methods of production, storage conditions and shelf life, preparation and/or handling before being processed, packaging and delivery methods

Hazard assessment shall be conducted to determine each food safety hazard identified whether its elimination or reduction to acceptable levels is essential to the production of a safe food, and whether its control is needed to enable the defined acceptable levels to be met. Each food safety hazard shall be evaluated according to the possible severity of adverse health effects and the likelihood of their occurrence.

3.1 Safety analysis results – control of CCPs

The results of the analysis for the quality and safety hazards of the delicatessen industry are presented in Table 6. The Table should be used as complementary to the following results. Incoming materials and especially raw meat used in large quantities is a sensitive food as it may support the growth of microbes. For this reason the raw materials delivery is characterised as a Critical Control Point (CCP 1) and should be examined upon each receipt. Certified suppliers and rigorous criteria for raw materials, additives with low microbial counts and the absence of pathogens could greatly contribute to the hygiene quality and safety of the final product. Food handling errors, inadequate storage practices and improper holding temperatures may also occur [10].

Table 5: Risk assessment result (M: microbiological, C: chemical, P: physical dangerous).

Stage of the flow chat (Fig.1)	Danger	Severity (S)	Probability (P)	Risk=S+P	Category CCP/GMP
Receipt/storage of olives	M	1	2	3	GMP
	C	1	2	3	GMP
	P	1	2	3	GMP
Transfer of the olives to the leaf remover	M	2	1	3	GMP
	C	2	1	3	GMP
	P	1	1	2	GMP
Washing of olives	M	2	1	3	GMP
	C	1	1	2	GMP
	P	2	2	4	CCP 1
Breaking of the fruit	M	2	1	3	GMP
	C	2	1	3	GMP
	P	1	2	3	GMP
Milling of the fruit	M	2	1	3	GMP
	C	1	1	2	GMP
	P	1	1	2	GMP
Kneading of the fruit	M	2	2	4	CCP 2
	C	2	2	4	CCP2
	P	1	1	2	GMP
The olive paste goes to the centrifuge	M	1	1	2	GMP
	C	1	1	2	GMP
	P	1	1	2	GMP
Filtration of the olive oil	M	1	2	3	GMP
	C	1	1	2	GMP
	P	2	2	4	CCP 3
Final filtration of the olive oil	M	1	1	2	GMP
	C	1	1	2	GMP
	P	1	2	3	GMP
Place the olive oil into the clients' pots	M	2	1	3	GMP
	C	1	1	2	GMP
	P	2	1	3	GMP
Storage	M	2	1	3	GMP
	C	1	0	1	GMP
	P	1	1	2	GMP
Receive from the client	M	1	1	2	GMP
	C	1	0	1	GMP
	P	1	1	2	GMP

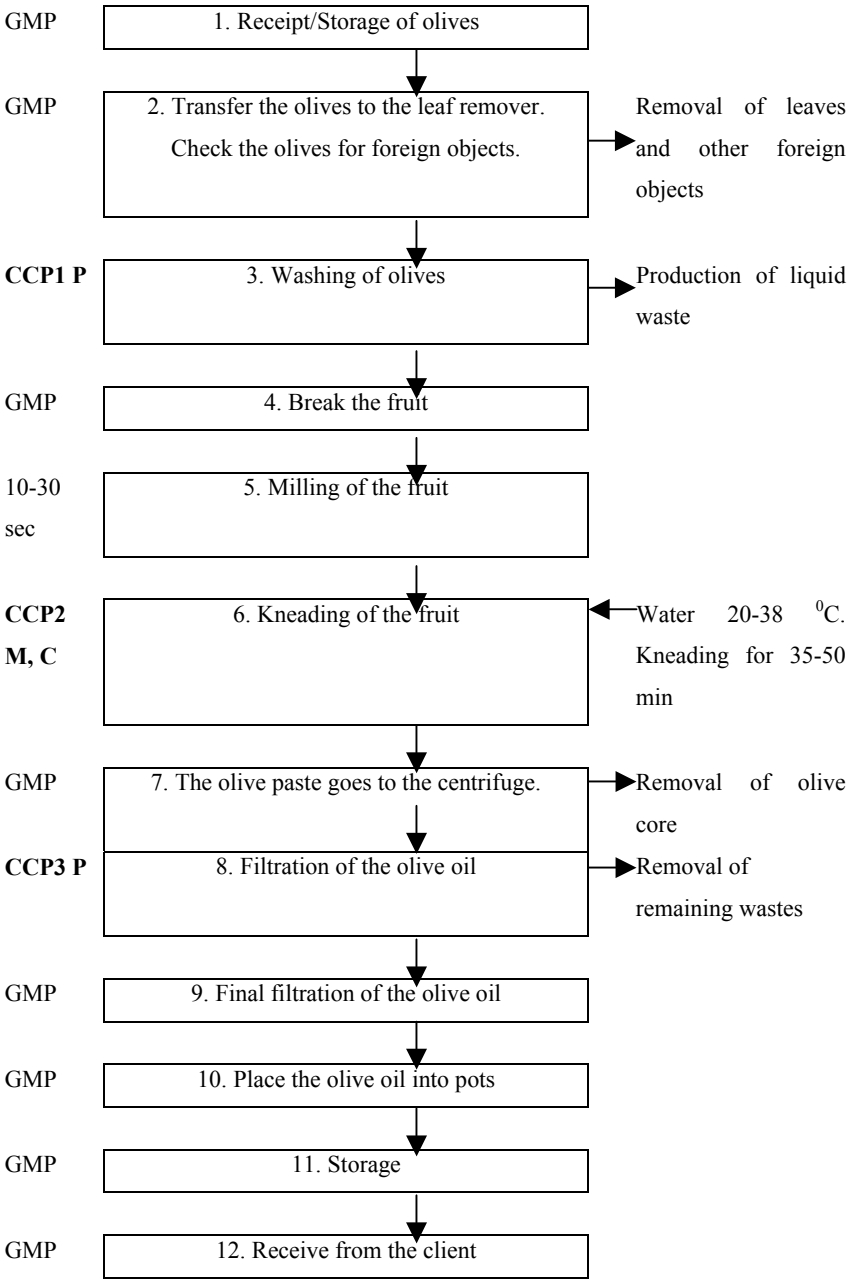

Figure 1: Olive oil production flow chat.

Table 6: HACCP sheet – analysis for the safety hazards, CCPs and their control M: microbiological, C: chemical, P: physical hazards.

Stage of the flow chart (Fig.1)	Hazards	Critical factors/limits/controls	Preventative measures
1	Microbiological: infection due to: Inefficient cleaning of the products, Damage to the fruit, High temperature due to transfer Chemical: Development of toxic substances in the fruit, Presence of pesticides Physical: Presence of foreign objects (dust, metal, mouse/insect waste), Temperature of storage not too high. If the olives remain in the storage room for days the temperature to be lower than 12 ^{0}C.	Microbiological: No presence of olive moth (*Prays oleae)*, olive fly (*Bactrocera oleae*), black beetle (*Saissetia oleae*), thrips (*Liothrips oleae*), scholytids (*Phloeotribus scarabeoide*), otiorrhynchus weevil (*Otiorrhynchus* sp.), peacock spot (*Cycloconium oleaginum*), olive knot (*Pseudomonas savastanoi*), sooty mould (a complex formed of *Spilocaea oleagina*, *Cupnodium* sp, *Cladosporium* sp. and *Alternaria* sp.) Chemicals: No pesticides or toxic substances present Physical: No presence of foreign objects. Store in a place where the temperature is not over 12^{o}C.	Microbiological: Good cleaning of the olives and of the transportation, Good ventilation of the olives during transportation to the olive press, Use of wooden crates, Careful transportation to the olive press so as not to damage the olives Chemical: Chemical testing if the client asks for it Physical: Check if the transportation vehicle is clean, Train the staff in cleaning, Optical check of the olives, Check of the olives' temperature
2	Physical: Check the olives for foreign objects, Presence of leaves, foreign objects such as metals, dust, insects	Physical: Presence of foreign objects.	Physical: Optical check of the olives for foreign objects, Good maintenance of the machines

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Table 6: Continued.

3 (CCP 1 P)	Microbiological: due to: Inadequate cleaning and disinfection of the equipment, No GHP Infection of the water Chemical: Toxic substances due to water infections Physical: Presence of foreign objects	Microbiological: E.coli, Listeria sp, Staphylococcus aureus and Clostridium perfringens must be <20, Salmonella Cambylobacter, V. Cholerae V. parahaemolyticus, L. monocytogenes absent in 15gr. Bacillus cereus and others <10. Chemical: No toxic substances Physical: No foreign objects	Microbiological: Check the cleaning of the equipment, The staff must follow good hygiene and good manufacturing practice, Microbial testing of the water Chemical: Yearly chemical testing of the products Physical: Optical testing to check if the equipment is cleaned, Frequent maintenance
4	Physical: Presence of objects such as metals	Physical: No presence of foreign objects	Physical: Frequent maintenance of the equipment
5	Microbiological: Presence/Growth of microorganisms due to increased temperature and time in the mill. Physical: Presence of foreign objects	Microbiological: E.coli, Listeria sp, Staphylococcus aureus and Clostridium perfringens must be <20. Salmonella Cambylobacter, V. Cholerae V. parahaemolyticus, L. monocytogenes absent in 15gr. Bacillus cereus and others <10. Chemical: No toxic substances. Physical: No foreign objects	Microbiological: Check of the room temperature, Check the time that the product stays in the mill Physical: Cleaning and disinfection of the equipment
6	Physical: Presence of foreign objects: Metals from the equipment, Presence of insects and rodents, Using water with temperatures outside of the normal rate, Milling the products more than they should be	Physical: No presence of foreign object, Water must be between 20–38^{o}C, Kneading for 35–50 minutes	Physical: Maintenance of the equipment, Putting in a system for killing insects and rodents (pest control), Measurement of the water temperature, Equipment Calibration (once a year), Check of the product temperature and the time of kneading

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Table 6: Continued.

7	Physical: Presence of foreign objects: Metals from the equipment, Presence of insects and rodents	Physical: No presence of foreign objects in the olive paste	Physical: Frequent maintenance of the equipment, Putting in a system for killing insects and rodents (pest control)
8 (CCP3 P)	Physical: Presence of foreign objects such as metals from the equipment	Physical: No presence of foreign objects in the oil	Physical: Frequent maintenance of the equipment
9	Physical: Presence of foreign objects such as metals from the equipment	Physical: No presence of foreign objects in the oil	Physical: Frequent maintenance of the equipment
10	Physical: Presence of foreign objects such as metals from the equipment, dust, insects, glass Chemical: Tang of the olive oil	Physical: No presence of foreign objects in the olive oil Chemical: The olive oil must not be sour	Physical: Optical check of the pots (especially the cap) before use, Implement good hygiene practice Chemical: Oil temperature, The pats must close very well as oxygen with the olive oil causes tang, The pots must not be made from iron, copper or nickel because they help with the oxidation
11	Chemical: Tang of the olive oil	Chemical: No tang in the olive oil	Chemical: Room temperature 10–15^{o}C, No intense light
12	Physical: Presence of foreign objects bad handling by the staff	Physical: No presence of foreign objects	Physical: Implement good manufacturing and hygiene practices

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Table 7: General GHPs – GMPs per stage.

Stage of the flow chart (Fig.1)	Good Hygiene Practices – Good Manufacturing Practices
Receipt/storage of olives	The receipt of the olives must be done in a roofed place. The olives must not come into contact with the olive oil. Storage that is being used for diesel and pesticides must not be used for olives because the smell will go to the olive oil.
Transfer the olives to the leaf remover. Check the olives for foreign objects	Remove as much of the leaves and foreign objects as possible because they give a sour taste to the olive oil.
Washing the olives	Microbiological testing of the water that is used in the equipment for washing the olives.
Breaking the fruit	Good maintenance of the equipment.
Milling of the fruit	Good maintenance of the equipment. The milling lasts about 10–30 seconds, depending on the olives.
Kneading of the fruit	Good maintenance of the equipment. The kneading lasts about 35–50 minutes, depending on the olives.
The olive paste goes to the centrifuge	Water temperature must be 30^{o}C. The cleaning of the centrifuge must be done twice a week for the manual and every day for the single type of centrifuge. The temperature of olive presses that use centrifugal force must not exist $30^{o} \pm 3^{o}$C.
Filtration of the olive oil	The filters must be cleaned according to the cleaning program. The filters must be cleaned when necessary.
Final filtration of the olive oil	The filters must be cleaned according to the cleaning program. The filters must be cleaned when necessary. The second filters are cleaned automatically twice a day and every 15 days are disassembled and cleaned more thoroughly.
Place the olive oil into the clients' pots	The pots must be checked before they are used. The pots must be suitable for olive oil.
Storage	The olive oil must be in a store room with a temperature of 10–15^{o}C, no humidity and no light. The olives must be in pots with as little air as possible. No use of pots made of metals such as iron, nickel, copper etc. No use of light lamps because the olive tangs.
Receive from the clients	The clients' pots must be cleaned and be without any smell.

3.2 GHPs – GMPs

Table 7 presents all the stages of the GMP and GHP in order to avoid contamination. In addition to the most significant factors and the relative required controls involved with CCPs, the rest of the factors in those stages must be controlled in order to assure the purpose of the quality and safety. Such controls usually are prerequisite meters, which are grouped and organized by means of hygiene practices. The processes of Olive Oil Industries include stages that are not under the Industry responsibilities. All the requirements related to hygiene practice during the industry operation either refer to equipment maintenance or to cleaning/disinfection procedure of equipment and the practice for foreign matters must be included in the prerequisite programs (PRPs).

4 Conclusions

The detailed analysis of the safety and hygienic factors affecting the quality and safety of the whole process of the examined delicatessen products (sausages, ham, bacon, lountza, hiromeri) approved that the controls of CCPs relative to the raw material specification, the temperature in the retaining and thermal processing steps, as well as the PRPs relative to the hygienic conditions during production should be satisfied.

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