Implementation of Food Safety Management in the Food Industry in Algeria: Benefits and Barriers Factors

Nouara Boulfout1,2,*, Fatima Brabez2,b
1Centre de Recherche en Economie Appliquée pour le Développement-CREAD, Rue Djamel Eddine El-Afghani - El Hammadia BP.197 Rostomia Bouazareah, Algeria
2Ecole Nationale Supérieure Agronomique, Hassen Badi, El Harrach 16004, Algeria
*Corresponding author

ABSTRACT

The key objective of this research review is to elucidate the mechanisms for applying a food safety scheme based on the Hazard Analysis and Critical Control Points (HACCP) system and to identify the difficulties and benefits of this technique (HACCP) in Algeria. Characterization of food processing companies around the capital of Algeria was carried out on the basis of questionnaires and direct interviews with the manager in charge of these companies. Forty-six agri-food firms working in the Algiers region and operating in the field for more than 15 years (80.5%) with Joint Stock company (JSC) status (23.9%), Limited Liability Company (LLC) (63%) and multinational companies (26.1%). The establishment of a transparent and effective framework for food safety controls will enable compliance with customer requirements, improved product quality and a stronger commitment to food safety managers. This is favorably correlated with the age as well as the level of education of the managers of the different surveyed companies. The survey conducted in the Algerian region showed that the key barriers to the introduction of the food safety management system (FSMS) in general are inadequate knowledge and competence of the HACCP and a long time to be developed FSMS, a lack of expertise and technical support and a lack of specialized expertise, intelligence and technological assistance to help the small and medium-sized enterprises (SME). The findings of the survey also revealed that the key reason for the introduction of the FSMS is to strengthen product protection, recognize the strengths and shortcomings of the business, enhance relationships with suppliers and enhance government and consumer confidence.

Introduction

The agri-food industries sector has grown vigorously over the past 20 years. According to ONS (2019) agriculture and the agri-food sector account for nearly 23% of the working population. The study of Bessaoud et al., (2019) shows that the sector is private to more than 80%, it contributes today from 50 to 55% of industrial GDP excluding hydrocarbons. It is the largest employer in the industrial sector (40% of employment with nearly 150,000 employed) (Bessaoud et al., 2019). The development of the agricultural and agri-food sector is a major issue for Algeria at the economic, political and social levels; it is the second industry of the country, after that of energy (Bessaoud et al., 2019). The cause for this growth is a rise in personal disposable income, a desire for more affordable food and an increase in urbanization. The Algerian food industry includes many fields, including meat, poultry and dairy products, fruit and vegetables, confectionery and snacks, cereals, fats, drinks and sea food. Although many food processors recognize that simple food safety and sanitation measures are critical to protecting consumers and their integrity, numerous claims of bad practices continue to erode customer trust in the sector (Tang and Babich, 2014; Aworth, 2021). This requires the application of a good protocol concerning the food safety system. “Food safety” is a wider term, which means ensuring that food does not affect the customer when it is processed and/or consumed in compliance with its intended use (Henson and Caswell, 1999; Seward II, 2003; Raspor, 2008; Grover et al., 2016). While most food processors understand that simple food protection and sanitation programs are required to protect customers and their reputations, recurrent allegations of malpractices continue to weaken consumer trust in the business (Jia and Jukes, 2013; Joanna and Wojciech, 2017; Al-Busaidi et al., 2017;...
Panghal et al., 2018). Consumer fears over food-related therapies are increasing. As a result of recent food shortages such as those seen in Europe and America, food security and food safety have become a hot subject in the public sphere (Miraglia et al., 2009; Walls et al., 2019; Flynn et al., 2019). The agri-food sector in Algeria is dominated by small and medium enterprises (SME), most of which do not have a food safety management system. However, as the Algerian National Agriculture Agency has revealed, most agribusinesses fall into the group of small and medium-sized companies, most of which have not obtained formal basic training in food safety. Barriers and incentives to implement food safety management systems (FSMS) such as HACCP and ISO 22000 in the food manufacturing sector in Algeria have not yet been studied. Research has shown that the obstacles and barriers to the incorporation of a third party approved food safety scheme depends on the scale of the business (Karipidis et al., 2009; Christos et al., 2011; Dora et al., 2013; Giacomarra et al., 2016) or on the industry type (Kuepper and Batt, 2012; Chaoniruthisai et al., 2018). To this end, various national programs recognised at international level have been used to guarantee and prevent food safety. These systems are defined in particular by the implementation at national level of the hygiene codes, the HACCP scheme, the British Retail Consortium (BRC), and the Healthy Quality Food Consortium (SQF). Since its introduction in the 1990s, the HACCP system has been known as the food safety system of choice, and this voluntary solution has been adopted by Europe and North America at industry level. In addition, HACCP is a science-based framework that allows for the development and management of a continuous, cost-effective food safety policy. It also helps food producers to create a higher standard of food safety that could not be accomplished by merely adopting simple public hygiene practices (Gaze and Robert, 2015). However, it is more efficient to integrate HACCP with other quality control frameworks and normal operating procedures, such as Good Production Practices (GMP) or Good Hygiene Practices (GHP) (KÖK, 2009; Karaman et al., 2012). In Algeria, food companies have adopted different programs such as HACCP and ISO 22000 based on HACCP (Ministry of Industry, 2019).

These initiatives have been broadly applied in the different food industries across the world (Papademas and Bintsis, 2010; Murphy, 2010; Karaman et al., 2012). As a result, the application of HACCP systems allow to evaluate, manage, and control the potential hazards and produce products free from different types of hazards (Beuchat et al., 2013). The food protection literature indicates that progress in designing, deploying, monitoring and verifying an effective HACCP system require a combination of management, operational and technological tools (Taylor, 2001; Fotopoulos et al., 2011). Also the largest food corporations, armed with essential tools, technological experts and management skills, may face challenges in implementing the HACCP method. Small or medium-sized enterprises (SMEs) can also assume that the complexities of HACCP are insurmountable. There are a variety of considerations that obstruct the application and execution of the HACCP scheme, such as the scope of the expertise or support available to companies, and include internal factors, while external factors include the inaccessibility of government or sector funding. The challenges vary from country to country and from business to industry (Jouve, 1994; Mortlock et al., 1999). Other issues may occur during the introduction of the HACCP method, such as lack of expertise, preparation, high turnover of employees, a wide amount of products, changing potential demand, rapidly changing workloads and a significant number of part-time personnel (Pierson, 2012; Sun and Ockerman, 2005). Moreover, the underlying reason for the non-application of food safety technology is the lack of awareness of these HACCP systems according to research performed in some food services, such as hospitals, food service companies, hotels, take-outs and restaurants. As far as we know, this study is the first to describe issues in the Algerian food industry concerning food safety. The primary aim of this research analysis is to identify the procedures for implementing a food safety system based on the HACCP Protocol, as well as to recognize the barriers and benifits of this system (HACCP) in Algeria. Questionnaires and direct interviews with the manager in charge of quality were used to characterize food processing firms in Blida and Algiers areas, in northern Algeria.

Methodology

Companies that use the HACCP system are included in this research. The Ministry of Industry, the National Chamber of Industry and Commerce and the Commerce Directorates provided the essential information on the agri-food companies, allowing 73 businesses in the Blida and Algiers areas to be identified. Each of these businesses was contacted by phone to confirm their desire to participate in the research on the benefits and barriers of implementing the HACCP system, and then the questionnaire was sent at the request of executive officers. Only 46 firms accepted the face-to-face interview and completed the questionnaires. This corresponds to a response rate of about 63%.

To conduct this research, a survey was designed with the help of both university colleagues (ENSA) and experts from consulting firms that assist companies in the development of food safety management systems. Before writing the research questionnaire, a pre-survey was conducted at the level of agri-food companies to evaluate the feasibility of the questionnaire and to closely observe the agri-business production method in order to address important concerns about the HACCP system’s implementation. This questionnaire approach was used to collect views and information on the application of the HACCP program, the experiences of food sector administrators and staff, as well as their perspectives on public facilities and local legal bodies in the field of food safety systems. During our visits to the targeted food processing firms, a questionnaire was distributed to executive officers of each organization, followed by interviews, several sessions, to ensure the accuracy of the answers. The face-to-face interviewing approach enabled conscientious persons and interviewees to publicly discuss their familiarity with the implemented HACCP for these companies.

In this study, SPSS (Statistical Package for Social Sciences, version 25) was used to conduct all statistical
analyses. First, the software was used to categorize and statistically analyze the variables using the descriptive statistics to characterize the agri-food companies. On the other hand, SPSS is used to conduct the statistical significance levels which were established at P<0.05 and P<0.01. Then Correlation analysis was used to assess correlation between educational level and age of managers and barriers-benefits of FSMS and expectations of plant managers from the legal authorities.

**Results and Discussion**

The implementation of the HACCP framework is a need for both the food industry and the customer for the development of a country (W.H.O, 2006; Chen and Voigt, 2020; Gordon et al., 2020). This HACCP system, due to its sensitivity within an organization, makes it possible to recognize the various hazards that can impact the food manufacturing, processing and production chain (Chen et al., 2015; Martinovic et al., 2016; Dzwolak, 2019; Mtewa et al., 2020). The adoption of this system is not a simple matter, particularly in under developed countries, since there are many restrictions that need to be addressed (Motarjemi and Mortimore, 2005; Schillhorn van Veen, 2005; Hobbs, 2010; Lee et al., 2012). These limitations are primarily due to a significant lack of infrastructure for safe processing and, in some situations, protocols have been established without prior planning to make these complex protocols work (Panisello and Quantick, 2001; Christos et al., 2011; Wallace, 2014; de Oliveira et al., 2016; Swainson, 2019). In the following sections, we will examine in detail the benefits and barriers for the surveyed food companies in Algeria.

**Descriptive Information on the Algerian Surveyed agri-food Companies**

Table 1 summarizes the results of the main characteristics of agri-food industry and managers of different agri-food companies in Algiers and Baida regions. According to these findings, the vast majority (80.5%) of agri-food companies have been in operation for more than 15 years analogous to the finding of Karaman et al., (2012) and have the legal status of JSC (23.9%) or LLC (50%). Most agri-food firms are involved in the fields of soft drink and juice distribution (16%), cheese production (20%), dairy production (14%), cereal manufacturing (8%), ice cream and sausage production (4%). More than half (63%) of managers employed in the agri-food industry are aged between 31 and 50 as mentioned in Chaoniruthisai et al., (2018). Most of these administrators are university graduates (91.3%) the remaining (8.7%) are high school graduates, similar to the finding of Fotopoulos et al. (2009) and Karaman et al. (2012).

**Improving Food Safety in Agri-food Companies**

In order to gain more insight into the advantages and contributions of introducing a food safety scheme at the firm level, detailed questions were raised about the management of these companies. As shown in Table 2, the majority of agri-food managers discussed the key benefits of implementing a food safety management system. The main advantages are improved product safety (100%), better working conditions (100%), better client concerns management (97.8%), stronger involvement of workers (95.6%), identifying the strengths and deficiencies of the company, improve relations with suppliers, raising awareness on health safety issues and increased trust in the availability of foodstuffs with an average of (92%).

Based on these findings, the application and operation of the HACCP method had significant benefits. Mensah and Julien, 2011 and Bas et al., 2007 have also reported similar findings.

The benefits of HACCP system in terms of food safety and efficiency as well as the improvement of protection steps would be expressed favourably by figures in food processing companies (Demirbas et al., 2008) and similar results have been reported by various studies (Shiferaw et al., 2000; Bucheri et al., 2007; Tokuç et al., 2009). The HACCP framework is used for the detection, review and monitoring of food product hazards before being sent to the consumer for purchasing or consumption. The HACCP scheme has been an obligation in Algeria for food processing firms. Additional benefits for the introduction of HACCP systems have been reported to satisfy regulatory standards and increase product quality and protection (Early, 2005; Fortin, 2013). Owing to the decline in product recalls, the opportunity to market goods at higher prices, minimize product waste and reduce manufacturing costs is also interesting (Scott, 2005; Yunus and Ray, 2007).

When senior managers were asked what they would like to do to strengthen food safety procedures in their facilities, a large percentage agreed with the need for a HACCP-based food safety management system.

| Table 1. Characteristics of agri-food industry and managers (n= 46). |
|---------------------------------------------------------------|
| **Characteristics** | **n(%)** |
| **Agri-Food business year of establish** | |
| less 5 years | 2(4.3) |
| 5-15 Years | 20(43.5) |
| 15-25 Years | 17(37) |
| >25 Years | 7(15.2) |
| **Education level** | |
| Secondary university | 4(8.7) |
| 42(91.3) |
| **Manager age** | |
| Less 30 | 2(4.3) |
| 31-50 | 29(63) |
| >50 | 15(32.6) |
| **Legal status of the company** | |
| JSC | 11(23.9) |
| LLC | 23(50) |
| Multinational | 12(26.1) |
| **Company field** | |
| Public | 1(2.2) |
| Private | 45(97.8) |
| **Agri-food company type** | |
| Cheese production | 10(20) |
| Production and distribution of soft drinks and juices | 8(16) |
| Transformation of cereals | 4(8) |
| Production of milk | 7(14) |
| Production of ice cream | 2 (4) |
| Charcutery | 2(4) |
However, the executives of the agri-food industry claimed that examination and control of safety of staff is more important than cleaning and disinfecting techniques and insect and pest management with a frequency of (100%), frequency of cleaning and disinfection and the location and design of the food-campaign are higher than (97%), availability of waste bins (86.9%), shipping, collecting, treating and holding (82.6%) (see Table 3). According to these administrators, these responses tend to improve the consistency and the operation of a successful food protection scheme.

It is also worth noting that the food industry executives interviewed for this study agree that implementing the HACCP protocol has more benefits than disadvantages, including the cost and time that this HACCP system would require in the production circuit, and its effect will be felt by the entire company’s employees. According to our research, it would be interesting to operate well on the basis of the location and design of the food company, cleaning and disinfecting techniques and their frequencies, availability of waste bins, shipping, collecting, treating and holding and examination and control of safety staff. These findings agree well with previous studies (Ropkins and Beck, 2000; Kokkinakis et al., 2011). Our results show that the staff interviewed agreed that the HACCP protocol enhances product safety. However, other studies have demonstrated that the HACCP-based food safety system is effective and can eliminate all foodborne illnesses in the food chain only if HACCP plans are properly established and understood (Demirbas et al., 2008; Wallace, 2014; Oyarzabal and Rowe, 2017; Dzwolak, 2019). Any company needs its own food safety scheme, with realistic and easy on-site checklists (De Sitter and van de Haar, 1998; Egan et al., 2007; Ropkins and Beck, 2000).

Table 2. Managers opinions on HACCP Benefits implementation.

| Responses                                           | n(%)                      |
|-----------------------------------------------------|----------------------------|
|                                                     | Strongly disagree | Disagree | Without An opinion | Agree | Strongly agree |
| Improved product safety                              | 2(4.3)                  | 10(21.7) | 24(52.2)           | 11(23.9) | 37(81.4) |
| Responding to certain calls for tender               | 8(17.4)                 | 30(65.2) | 38(82.6)           | 31(67.4) | 19(41.3) |
| HACCP has more restrictions than advantages          | 30(65.2)                | 13(28.3) | 6(13)              | 3(6.5)  | 15(32.6) |
| Identifying the strengths and deficiencies of the company | 6(13)                 | 1(2.2)   | 3(6.5)             | 31(67.4) | 15(32.6) |
| Stronger involvement of workers                      | 3(6.5)                  | 2(4.3)   | 26(56.5)           | 19(41.3) | 3(6.5)  |
| Enables to work in better conditions                | 2(4.3)                  | 30(65.2) | 15(32.6)           | 31(67.4) | 15(32.6) |
| Improve relations with suppliers                     | 2(4.3)                  | 11(23.9) | 24(52.2)           | 11(23.9) | 37(81.4) |
| Better management of client concerns                 | 1(2.2)                  | 6(13)    | 13(28.3)           | 3(6.5)  | 15(32.6) |
| Better manage client concerns                       | 3(6.5)                  | 2(4.3)   | 26(56.5)           | 19(41.3) | 3(6.5)  |
| Reduce the risk of food-borne illnesses              | 1(2.2)                  | 7(15.2)  | 33(71.7)           | 7(15.2)  | 33(71.7) |
| Raising awareness on health safety issues            | 7(15.2)                 | 22(47.8) | 15(32.6)           | 19(41.3) | 3(6.5)  |
| Increased trust in the availability of foodstuffs    | 5(10.9)                 | 11(23.9) | 24(52.2)           | 29(63)  | 31(67.4) |
| Increased quality of life (health and socio-economic) | 8(17.4)                 | 16(34.8) | 38(82.6)           | 22(47.8) | 8(17.4) |
| Increased government and consumer confidence         | 10(21.7)                | 31(67.4) | 15(32.6)           | 31(67.4) | 15(32.6) |

Table 3. The food company’s hygiene condition after implementing the HACCP system.

| Responses                                           | n(%)                      |
|-----------------------------------------------------|----------------------------|
|                                                     | Average | Favourable | More favourable |
| The location and design of the food-campaign        | 2(4.3)  | 24(52.2)   | 21(45.7)      |
| Cleaning and disinfecting techniques                | 8(17.4) | 15(32.6)   | 31(67.4)      |
| Frequency of cleaning and disinfection              | 6(13)   | 15(32.6)   | 30(65.2)      |
| Availability of waste bins                          | 1(2.2)  | 11(23.9)   | 29(63)        |
| Insect and pest management                          | 29(63)  | 33(71.7)   | 3(6.5)        |
| Shipping, collecting, treating and holding          | 13(28.3)| 16(34.8)   | 31(67.4)      |
| Examination and control of safety of staff          | 15(32.6)| 12(26.1)   | 3(6.5)        |

**Barriers and Difficulties Encountered in Implementing Food Safety Systems**

In order to examine the effects of the various restrictions on the introduction of an effective food safety scheme, a questionnaire was sent, prior to the face-to-face interview, to all the managers of the food processing firms involved in this study. The feedback is shown in Table 4. It can be seen that insufficient knowledge and competence of the HACCP, long time to set up and cost of application constitute the main barriers according to the participants of the survey. These are the reasons most responsible for the challenge of developing a successful food safety scheme. In the second position, lack of motivation and commitment of workers, lack of expertise and technical support, inadequate basic hygiene and lack of effective training and education programs identified by frequency varies from 95% to more than 97%. Lack of specialist expertise, intelligence and technological assistance to support SME account for 84.8% while difficulties relating to technologies and design of production account for only 23.9%.

It has previously been noted that small and medium-sized food companies are typically not in a position to enforce the HACCP recommendations due to their small size, lack of technological knowledge and preparation, high turnover of staff and limited capital (Azanza and Zamora-Luna, 2005; Wengle, 2016; Allata et al., 2017; Liu et al., 2021). Based on previous research, it was observed that the most important barrier to the introduction of a successful HACCP-based food safety system was resources shortage and a clear lack of awareness about the
food safety system (Jirathana, 1998; Taylor, 2001; Jevvsnik et al., 2006). However, it is widely accepted that it is very difficult to introduce the HACCP method in food companies and this is closely related to the psychological obstacles such as lack of knowledge of risk and morale of workers need to be addressed in order to enforce HACCP successfully (Gilling et al., 2001). This is reflected in an extension of lack of motivation and commitment of workers of more than 97.9% (see Table 4) (Taylor and Taylor, 2004; Joanne, 2008).

Based on the findings of this survey, insufficient knowledge and competence of the HACCP, long time to set up and cost of application are the major parameters that hinder the implementation of a successful HACCP protocol as shown in Table 4, results are also closely similar to prior works (Ramirez Vela and Martin Fernández, 2003; Jevvsnik et al., 2008; Motarjemi and Mortimore, 2014). On the other hand, the challenges of introducing the HACCP system in Algerian food firms have been described as the inadequacy of the facilities and the physical conditions of the institution (Al-Busaidi et al., 2017; Bas et al., 2006). Also, According to our report, it appears clearly that the lack of expertise and technical support described by the intensity of the documentation during the establishment of HACCP implementation (94.4%) represent a major barrier Table 4.

The challenges associated with tedious documentation in Algeria can be overcome by employing tools that minimize the amount of paperwork and thereby promote documentation in the execution of these programs. It was also proposed that food safety reporting and record keeping should not be a liability and may have several advantages other than conformity with the HACCP principles (Antle, 1996; Havinga, 2006; Antle, 1999; Manning and Baines, 2004). It is noted that the cost as well as the significant lack of understanding and preparation as such are among the most prominent barriers to the introduction of a food safety scheme in the agri-food sector based on the HACCP protocol (Karaman et al., 2012; Macheka et al., 2013; Rincon-Ballesteros et al., 2019). Among the obstacles to the introduction of HACCP in food enterprises in Algeria inadequate basic hygiene, insufficient training and the lack of local information sources on HACCP and employee training and financial resources are the most relevant. The results of this analysis matched those of the previous one (Bas et al., 2007). In other works, Youn and Sneed, 2002 recognized personnel and resource obstacles in the National School Food Service Directors Report (Sneed and Henroid, 2003; York et al., 2009). They documented that the major obstacles were lack of knowledge for workers and lack of financial support. The difficulties arise also regarding managers that have little or no previous experience in food safety or sanitation instruction. Indeed, the survey reveals a lack of adequate training for both administrators and employees (more than 95.7%) (Table 4).

In other studies carried out in various countries, it appears that among the difficulties faced in the implementation of the standardized HACCP method, the most significant was due to the necessity of handling of big datasets containing heavy documents (Mayes, 1998; Taylor, 2001; Kowalska and Manning, 2020; Berdik et al., 2021).

### Managerial Expectations for Government Support in Food Safety Systems

In the following, we will examine the commitment and funding of the state to the food processing companies under review, as well as the intentions of the managers of these companies for the state. The Chamber of Industry and Commerce and the Ministry of industry are the state-representing organizations. When asked if the Ministry could assist agri-food companies in introducing and preserving food safety programmes, managers concluded that the businesses who have benefited from government subsidies represent (37%) of them benefited from state support represented by the Ministry of industry. The majority of them have difficulty adapting to certain requirements provided by the public authority in order to receive these subsidies (63%). Any of the agribusinesses in question have benefited from foreign cooperation programs (34.8%) implemented by DIVICO 1 (European cooperation program for Algeria’s agricultural and agri-food industries). It’s worth noting that the businesses that have benefited from public assistance and have been reimbursed account for 32.6% of the total as shown in Table 5. In addition, the managers of the agri-food firms considered that the supports provided by the public authorities and international organisations mentioned above to set up a successful food safety scheme were related to the different costs that the companies had faced.

| Responses                                                                 | Strongly disagree | Rather disagree | Neutral | Rather agree | Strongly agree |
|--------------------------------------------------------------------------|-------------------|-----------------|---------|--------------|----------------|
| Insufficient knowledge and competence of the HACCP                       | 11(23.9%)         | 5(10.9%)        | 10(21.7%)| 14(30.4%)    |                |
| Long time to set up.                                                     |                   |                 | 10(21.7%)| 24(52.2%)    | 14(30.4%)      |
| Cost of application                                                      |                   | 1(2.2%)         | 15(32.6%)| 21(45.7%)    | 32(64%)       |
| Staff turnover.                                                          |                   | 1(2.2%)         | 1(2.2%) | 24(52.2%)    |                |
| Lack of motivation and commitment of workers                             |                   |                 |         |              | 14(30.4%)      |
| Lack of expertise and technical support (intensity of documentation).    |                   |                 | 1(2.2%) | 24(52.2%)    | 14(30.4%)      |
| Inadequate basic hygiene                                                 | 3(6.5%)           |                 | 32(69.6%)| 32(69.6%)    |                |
| Lack of effective training and education programs.                        | 1(2.2%)           |                 | 17(37%) | 27(58.7%)    |                |
| Lack of specialist expertise, intelligence and technological assistance to support SME | 7(15.2%)          |                 | 17(37%) | 22(47.8%)    |                |
| Difficulties relating to technologies and design of production.           | 13(28.3%)         | 22(47.8%)       | 10(21.7%)| 1(2.2%)      |                |

Table 4. Barriers identified by managers to implementing HACCP system (n= 46).
Table 5. Expectations of agri-food business from the legal authorities (n= 46).

| Responses                                                                 | n(%)     |
|---------------------------------------------------------------------------|----------|
| For businesses who have benefited from Government benefits                 | Yes 17(37.0) No 29(63.0) |
| If yes, was it done entirely?                                              | Yes 15(32.6) No 31(67.3) |
| Have the company benefited from a foreign development programme?           | Yes 16(34.8) No 30(65.2) |

Table 6. The costs of implementing the HACCP system (n= 46).

| Responses                                                                 | n(%)     |
|---------------------------------------------------------------------------|----------|
| Cost analysis of the product                                              | Not important 5(10.9) Little important 14(30.4) Important 21(45.7) Very important 4(8.7) Not concerned 2(4.3) |
| Cost investment in new equipment                                          | 1(2.2)   |
| Cost of staff training                                                    | 18(38.1) |
| the cost system documentation                                             | 7(15.2)  |
| Cost time spent on system documentation                                   | 5(10.8)  |
| Cost structural changes in the company                                    | 2(4.3)   |
| Cost upgrade of the system                                                | 3(6.5)   |

Table 7: Correlation between educational level and age of managers and barriers-benefits of FSMS and expectations of agri-food-- managers from the legal authorities. (n= 46).

| Responses                                                                 | Manager level | Manager age |
|---------------------------------------------------------------------------|---------------|-------------|
| System build time                                                         | -0.385        | 0.311       |
| Meet customer requirements                                                | 0.314         | -0.385      |
| Stronger management commitment to food safety                             | 0.324         | 0.426       |
| Application cost                                                          |               |             |
| Suppliers that aren’t a great fit for the company                         |               |             |
| Improve product quality                                                   |               |             |
| Correlation is significant at the 0.05 level (2-tailed)                   |               |             |
| Correlation is significant at the 0.01 level (2-tailed)                   |               |             |

Discussions with managers of agribusinesses in Algeria have confirmed that the Ministry of Industry has various programs of technical assistance to agribusinesses, as well as training sessions for managers and technicians of these companies. Support and expertise of consultants approved by the State and specialized in a particular field are also available. On the other hand, one should be aware that several firms have found it difficult to secure funding on the basis of the documentation required by the government. Among the problems encountered in introducing food safety programs, the managers in this study concluded that it is difficult for enterprises to obtain government support (63%) and that 65.2% of enterprises have not benefited from international development programs as shown in Table 5.

In the first position, the investment cost of in new equipment (82.6%), the cost time spent on system documentation (73.9%), next the cost structural changes in the company (69.6%) and the other costs represented by analysis of the product (54.4%), cost upgrade of the system (50%) and finally the cost system documentation (39.1%) as shown in Table 6.

On the basis of these findings and the studies recently carried out, the opinion of managers affirms the control over the whole chain of food industry in order to enforce a successful food protection regime in these companies and also to ensure the processing of the various goods manufactured by these companies (Rodrigues et al., 2019; Tsai et al., 2021). Previous findings indicate that, in order to incorporate an effective HACCP framework, many forms, methods, guidelines and plans are required, in addition to the study and validation of the HACCP system, to be applied in compliance with the requirements, requiring extensive demands for documents that were time intensive and complicated (Mari et al., 2013; Green and Kane, 2014; Zwietering, 2015). The production and introduction of solid written standard operating procedures in the food industry is one of the challenging phases needed to implement successful HACCP and other food safety programs in agri-food business (Taylor, 2001; Route, 2001; Taylor and Kane, 2005; Jin et al., 2008).

A correlation test has been performed in order to examine the relationship between the main parameters that can affect the phase of a successful HACCP protocol, as shown in Table 7. According to the obtained results (Table 7), there is a strong correlation between manager level education and satisfying customer and regulatory requirements, as well as a higher level of management commitment to food protection on the one side, and manager age and improving product quality and application cost on the other hand. It should also be remembered that, on the one hand, there is a negative correlation between system build time and manager-level instruction, and on the other hand, there is a negative correlation between suppliers who aren’t a good match for the business.

The implementation of the HACCP food safety protocol is focused on operating as a group rather than recruiting people on their own (Azanza and Zamora-Luna, 2005; De Oliveira et al., 2016; Despoudi, 2021). In this way, collaboration and employee engagement in the growth of the HACCP framework may be a significant part.
of staff motivation (Gilling et al., 2001; Liu et al., 2021). Similar surveys have confirmed that, as the standard of preparation of company staff grows, their demand for assistance from government agencies in terms of consultation on HACCP activities is diminishing (Jin et al., 2008; Wen-Hwa, 2013; Al-Busaidi et al., 2017). This inverse proportionality indicates that the application of FSMS to agri-food firms could increase by hiring plant managers from highly trained operators (Table 7). What might be clear is that, as the level of education of managers in agri-food industries is high at a certain level, the rate of daily product protection inspections that feed their companies in the various supply chains will increase (Demirbas et al., 2008; Qian et al., 2011) (see Table 7).

Conclusion

The goal of this work was to assess the implementation of a food safety management system in the Algerian agrifood industry and to examine barriers and advantages. Based on the findings obtained during this review, it is clear that the following are among the key obstacles encountered during the implementation of the HACCP scheme: insufficient knowledge and competence of the HACCP, long time to set up, cost of application, lack of expertise and technical support, inadequate basic hygiene and lack of effective training and education programs. It should be noted that the managers questioned agreed that while the HACCP scheme has constraints, the advantages are greater, it nevertheless helps to, identify the strengths and shortcomings of the business, and particularly to spot better conditions of operation and strengthening the bonds with suppliers. It is also worth noting that when managers were asked what pertinent steps should be taken in order enhance food protection in their businesses, they agree that cleaning and disinfecting procedures, the intensity of cleaning and disinfection and the assessment and supervision of safety personnel were the key criteria that could help to enforce a successful HACCP framework. According to the findings obtained previously, it has also been found that the challenge of implementing the HACCP scheme at the level of an agro-food business depend on public support on the basis of a national development program. Moreover, our findings also indicate that training and a better knowledge for food company managers and workers is vital for the successful operation of the HACCP system. The Government must provide financial assistance for the establishment of FSMS in these plants and support the long-term maintenance of FSMS in the industry. In addition, public services represented by the Ministry of Agriculture, as well as local and regional services, need to improve and diversify consulting services in order to improve the implementation of a good HACCP system, particularly for microenterprises. In addition, good cooperation between universities, public services and food companies could afford these companies the best chances of success.

Acknowledgements

The authors would like to thank the Center of Research in Applied Economics for Development-CREADE for financing and facilitating the field surveys.

References

Allata S, Valero A, Benhadja L. 2017. Implementation of traceability and food safety systems (haccp) under the iso 22000:2005 standard in North Africa: The case study of an ice cream company in Algeria. Food Control, 79:239–253, DOI: https://doi.org/10.1016/j.foodcont.2017.04.002.

Antle JM. 1996. Efficient food safety regulation in the food manufacturing sector. American Journal of Agricultural Economics, 78(5):1242–1247, DOI: https://doi.org/10.2307/1243500.

Antle, J. M. 1999. Benefits and costs of food safety regulation. Food Policy, 24(6): 605–623. Awhor, O. C. (2021). Food safety issues in fresh produce supply chain with particular reference to sub-saharan Africa. Food Control, 123:107737, DOI: https://doi.org/10.1016/S0306-9192(99)00068-8.

Azanza MV, Zamora-Luna MBV. 2005. Barriers of haccp team members to guideline adherence. Food Control, 16(1):15–22, DOI: https://doi.org/10.1016/j.foodcont.2003.10.009.

Bas M, Ersun A.S, Kïvânc G. 2006. Implementation of haccp and prerequisite programs in food businesses in turkey. Food Control, 17(2):118–126, DOI: https://doi.org/10.1016/j. foodcont.2004.09.010.

Bas M, Yüksel M, Çavuş souglu T. 2007. Difficulties and barriers for the implementing of haccp and food safety systems in food businesses in turkey. Food Control, 18(2):124–130, DOI: https://doi.org/10.1016/j.foodcont.2005.09.002.

Berdik D, Otoum S, Schmidt N, Porter D, Jararweh Y. 2021. A survey on blockchain technology for food systems management and security. Information Processing & Management, 58(1):102397, DOI: https://doi.org/10.1016/j.ipm.2020.102397.

Bessaoud O, Pelissier JP, Rolland, JP, Khechimi, W. 2019. Rapport de synthèse sur l’agriculture en Algérie. Rapport de recherche, CHEMEAM-JIAMP, pp.82. hal-02137632, DOI: https://hal.archives-ouvertes.fr/hal-02137632/document.

Beuchat LR, Komitopoulou E, Beckers H, Bourdichon F, Fanning S, Joosten HM, Ter Kuile BH. 2013. Pathogens in activity foods: increased concern as vehicles of foodborne pathogens. Journal of Food Protection, 76(1):150–172, DOI: https://doi.org/10.4315/0099-1324-JFP-12-111.

Bucher C, Casuccio A, Giannanco S, Giannanco M, La Guardia M, Mammina C. 2007. Food safety in hospital: knowledge, attitudes and practices of nursing staff of two hospitals in Sicily, Italy. BMC health services research, 7(1):1–11, DOI: https://doi.org/10.1186/1472-6963-7-45.

Chaalnithaisi P, Punnakinikashem P, RajcharaMa h K. 2018. Challenges and difficulties in the implementation of a food safety management system in Thailand: A survey of brc certified food productions. Food Control, 93:274–282, DOI: https://doi.org/10.1016/j.foodcont.2018.06.004.

Chen E, Flint S, Perry P, Perry M, Lau R. 2015. Implementation of non-regulatory food safety management schemes in New Zealand: A survey of the food and beverage industry. Food Control, 47:569–576, DOI: https://doi.org/10.1016/j.foodcont.2014.08.009.

Chen X, Voigt T. 2020. Implementation of the manufacturing execution system in the food and beverage industry. Journal of Food Engineering, 278:109932, DOI: https://doi.org/10.1016/j.jfoodeng.2020.109932.

Christos F, Dimitrios K, Katerina G. 2011. Critical factors for effective implementation of the haccp system: a Pareto analysis. British Food Journal, 113(5):578–597, DOI: https://doi.org/10.1108/00070701111131700.

De Oliveira CAF, Da Cruz AG, Tavolaro P, Corassin CH. 2016. Food Safety: Good Manufacturing Practices (GMP), Sanitation Standard Operating Procedures (SSOP), Hazard Analysis and Critical Control Point (HACCP). In: Antimicrobial food packaging, Chapter 10 (pp. 129–139), Yasmine Motarjemi (editor). Academic Press, DOI: https://doi.org/10.1016/B978-0-12-800723-5-00010-3.
De Sitter H, Van de Haar S. 1998. Governmental food inspection and HACCP. Food Control, 9(2-3), 131-135, DOI: https://doi.org/10.1016/S0956-7135(98)00083-8.

Demirbas N, Gölgé E, Tosun D, Cukur F. 2008. Food safety practices in milk collection centers in Turkey: a case study. British Food Journal, 110(8):781–789, DOI : https://doi.org/10.1108/00070700810893313.

Despondi S. 2021. Challenges in reducing food losses at producers’ level: The case of Greek agricultural supply chain producers. Industrial Marketing Management, 93, 520–532, DOI: https://doi.org/10.1016/j.indmarman.2020.09.022.

Dora M, Kumar M, Van Goubergen D, Molnar A, Gellynck X. 2013. Food quality management system: Reviewing assessment strategies and a feasibility study for European small and medium-sized enterprises. Food Control, 31(2):607–616, DOI: https://doi.org/10.1016/j.foodcont.2012.12.006.

Dzwołak W. 2019. Assessment of haccp plans in standardized food safety management systems – the case of small-sized polish food businesses. Food Control, 106:106716, DOI: https://doi.org/10.1016/j.foodcont.2019.106716.

Early R. 2005. Good agriculturall practice and HACCP in fruit and vegetable cultivation, chapter 7, pages 229–267. In: Woodhead Publishing Series in Food Science, Technology and Nutrition. Woodhead Publishing, DOI: https://doi.org/10.1533/9781845690243.2.229.ISBN 9781855739567.

Egan MB, Raats MM, Grubb SM, Eves A, Lumbbers ML, Dean MS, Adams MR. 2007. A review of food safety and food hygiene training studies in the commercial sector. Food Control, 18(10):1180–1190, DOI: https://doi.org/10.1016/j.foodcont.2006.08.001.

Flyn K, Villarreal BP, Barranco A, Belc N, Björnssödtt B, Fusco V, Rainieri S, Smanadottir SE, Smue I, Teixeira P, Jörundssödtt Hö. 2019. An introduction to current food safety needs. Trends in Food Science & Technology, 84:1–3, DOI: https://doi.org/10.1016/j.tifs.2018.09.012.

Fortin ND. 2013. HACCP and Other Regulatory Approaches to Prevention of Foodborne Diseases, chapter 35, pages 497–510. Food Science and Technology. In: Academic Press, San Diego. DOI : https://doi.org/10.1016/B978-0-12-819519-2.00006-2.ISBN 9780124160415.

Fotopoulos C, Kaftzopoulos D, Gotzamani K. 2011. Critical factors for effective implementation of the HACCP system: A Pareto analysis. British Food Journal.

Gaze, Robert. 2015. HACCP: a practical guide. Campden BRI Chipping Campden, UK. ISBN: 9780907503828, 9007503829.

Giacomarra M, Galati A, Crescimanno M, Tinervia S. 2016. The integration of quality and safety concerns in the wine industry: the role of third-party voluntary certifications. Journal of Cleaner Production, 112:267–274, DOI: https://doi.org/10.1016/j.jclepro.2015.09.026.

Gilling SI, Taylor EA, Kane K, Taylor JZ.2001. Successful hazard analysis critical control point implementation in the United Kingdom: understanding the barriers through the use of a behavioral adherence model. Journal of Food Protection, 64(5), 710-715. DOI: https://doi.org/10.4310/0362-028X-64.5.710.

Gordon A, DeVlieger D, Vasan A, Bedard B. 2020. Technical considerations for the implementation of food safety and quality systems in developing countries, Chapter 1, pages 1–40. In: Academic Press, DOI : https://doi.org/10.1016/B978-0-12-814272-1.00001-2. ISBN: 9780128094468.

Green RM, Kane K. 2014. The effective enforcement of haccp based food safety management systems in the UK. Food Control, 37:257–262, DOI: https://doi.org/10.1016/j.foodcont.2013.09.016.

Grover AK, Chopra S, Mosher GA. 2016. Food safety modernization act: A quality management approach to identify and prioritize factors affecting adoption of preventive controls among small food facilities. Food Control, 66:241–249, DOI: https://doi.org/10.1016/j.foodcont.2016.02.001.

Havinga T. 2006. Private regulation of food safety by supermarkets. Law & Policy, 28(4):515–533, DOI : https://doi.org/10.1111/j.1467-9930.2006.00237.x.

Henson S, Caswell J. 1999. Food safety regulation: an overview of contemporary issues. Food Policy, 24(6):589–603, DOI: https://doi.org/10.1016/S0306-9192(99)90072-X.

Hobbs JE. 2010. Public and private standards for food safety and quality: international trade implications. Estey Journal of International Law and Trade Policy, vol. 11, no 1753-2016-141207, p. 136-152. DOI: 10.22004/ag.econ.90586 1496-5208.

Jevvsnik M, Hlebec V, Rasper P. 2006. Meta -analysis as a tool for barriers identification during haccp implementation to improve food safety. Acta Alimentaria, 35(3):319–353, DOI : https://doi.org/10.1556/alimn.35.2006.3.9.

Jevvsnik M, Hlebec V, Rasper P. 2008. Food safety knowledge and practices among food handlers in Slovenia. Food Control, 19(12) :1107–1118, DOI : https://doi.org/10.1016/j.foodcont.2007.11.010.

Jia C, Jukes D. 2013. The national food safety control system of china – a systematic review. Food Control, 32(1):236–245, DOI: https://doi.org/10.1016/j.foodcont.2012.11.042.

Jin S, Zhou J, Ye J. 2008. Adoption of haccp system in the Chinese food industry: A comparative analysis. Food Control, 19(8):823–828, DOI: https://doi.org/10.1016/j.foodcont.2008.01.008.

Jurithana P. 1998. Constraints experienced by developing countries in the development and application of haccp. Food Control, 9(2):97–100, DOI: https://doi.org/10.1016/S0956-7135(98)00011-5.

Joanna T, Wojciech K. 2017. Implementation and functioning of haccp principles in certified and non-certified food businesses: A preliminary study. British Food Journal, 119(4):710–728, DOI: https://doi.org/10.1108/BFJ-07-2016-0313.

Jone ZT. 2008. Haccp for the hospitality industry: a psychological model for success. International Journal of Contemporary Hospitality Management, 20(5):508–523, DOI: https://doi.org/10.1108/095969610810881445.

Jouve JL. 1994. Haccp as applied in the EEC. Food Control, 5(3):181–186, DOI:https://doi.org/10.1016/S0956-7155(99)400080-9.

Karaman AD, Co banoglu F, Tunalioğlu R, Ova G. 2012. Barriers and benefits of the implementation of food safety management systems among the turkish dairy industry: A case study. Food Control, 25(2) :732–739, DOI : https://doi.org/10.1016/j.foodcont.2011.11.041.

Karipidis P, Athanassiadis K, Aggelopoulos S, Giompliakis, E. 2009. Factors affecting the adoption of quality assurance systems in small food enterprises. Food Control, 20(2) 93–98, DOI : https://doi.org/10.1016/j.foodcont.2008.02.008.

KÖK MS . 2 009. Application of food safety management systems (iso 22000/haccp) in the turkish poultry industry : A comparison based on enterprise size. Journal of Food Protection, 72(10) :2221–2225, DOI : https://doi.org/10.3103/S0362-028X-72.10.2221.

Kokkinakis E, Kokkinaki A, Kyriakidis G, Markaki A, Fragiakdakis, G. A. 2011. Haccp implementation in local food industry: a survey in crete, greece. Procedia Food Science, 1 :1079–1083, DOI : https://doi.org/10.1016/j.profoo.2011.09.161.

Kowalska A Manning L. 2020. Using the rapid alert system for food and feed: potential benefits and problems on data interpretation. Critical Reviews in Food Science and Nutrition, pages 1–14, DOI : https://doi.org/10.1080/10408398.2020.1747978.

Kuepper G, Batt PJ. 2012. The adoption of quality management systems in the fresh produce industry in western Australia. In ActaHortic., number 936, pages 27–34. International Society for Horticultural Science (ISHS), Leuven, Belgium, DOI : https://doi.org/10.17660/ActaHortic.2012.936.2.
Swainson M. 2019. Product control and hazard analysis and critical control point (HACCP) considerations, chapter 6 pages 123–163. Mark Swainson (editor) in: Woodhead Publishing Series in Food Science, Technology and Nutrition. Woodhead Publishing. DOI: https://doi.org/10.1016/B978-1-78242-275-4.00006-X. ISBN: 9781782422754

Tang CS, Babich V. 2014. Using social and economic incentives to discourage Chinese suppliers from product adulteration. Business Horizons, 57(4):497–508, DOI: https://doi.org/10.1016/j.bushor.2014.03.009.

Taylor E. 2001. Haccp in small companies: benefit or burden? Food Control, 12(4):217–222, DOI: https://doi.org/10.1016/S0956-7135(00)00043-8.

Taylor E, Kane, K. 2005. Reducing the burden of haccp on smes. Food Control, 16(10):833–839, DOI: https://doi.org/10.1016/j.foodcont.2004.06.025.

Taylor EA, Taylor JZ. 2004. Using qualitative psychology to investigate haccp implementation barriers. International Journal of Environmental Health Research, 14(1):53–63, DOI: https://doi.org/10.1080/09603120310001633877.

Tokuç B, Ekuklu G, Berberouglu U, Bilge E, Dedeler H. 2009. Knowledge, attitudes and self-reported practices of food service staff regarding food hygiene in Edirne, Turkey. Food Control, 20(6):565–568, DOI: https://doi.org/10.1016/j.foodcont.2008.08.013.

Tsai FM, Bui TD, Tseng ML, Ali MH, Lim MK, and Chiu, A. S. 2021. Sustainable supply chain management trends in world regions: A data-driven analysis. Resources, Conservation and Recycling, 167:105421, DOI: https://doi.org/10.1016/j.resconrec.2021.105421.

Wallace CA. 2014. Food Safety Assurance Systems: Hazard Analysis and Critical Control Point System (HACCP): Principles and Practice, pages 226–239. Academic Press, DOI: 10.1016/B978-0-12-378612-8.00358-9. ISBN: 9780123786135.

Walls H, Baker P, Chirwa E, Hawkins, B. 2019. Food security, food safety & healthy nutrition: are they compatible? Global Food Security, 21:69–71, DOI: https://doi.org/10.1016/j.gfs.2019.05.005.

Wen-Hwa K. 2013. The relationship among food safety knowledge, attitudes and self-reported haccp practices in restaurant employees. Food Control, 29(1):192–197, DOI: https://doi.org/10.1016/j.foodcont.2012.05.076.

Wengle S. 2016. When experimentalist governance meets science-based regulations; the case of food safety regulations. Regulation & Governance, 10(3):262–283, DOI: https://doi.org/10.1111/rego.12067.

York VK, Brannon LA, Shanklin CW, Roberts KR, Howells AD, Barrett EB. 2009. Foodservice employees benefit from interventions targeting barriers to food safety. Journal of the American Dietetic Association, 109(9):1576–1581, DOI: https://doi.org/10.1016/j.jada.2009.06.370.

You S, Sneed J. 2002. Training and perceived barriers to implementing food safety practices in school foodservice. The Journal of Child Nutrition & Management, 26(2):2002.

Yunus K, Ray C. 2007. Impact and status of haccp in the Australian meat industry. British Food Journal, 109(5):343–354, DOI: https://doi.org/10.1108/000707070710746768.

Zwietering MH. 2015. Risk assessment and risk management for safe foods: Assessment needs inclusion of variability and uncertainty, management needs discrete decisions. International Journal of Food Microbiology, 213:118–123, DOI: https://doi.org/10.1016/j.ijfoodmicro.2015.03.032.