

AMERICAN UNIVERSITY OF BEIRUT

BARRIERS TO IMPLEMENTING GMPS AND HACCP IN
LEBANESE FOOD INDUSTRIES

by
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A thesis
submitted in partial fulfillment of the requirements
for the degree of Masters of Sciences in Environmental Sciences
to the Interfaculty Graduate Environmental Sciences Program
(Environmental Health)
of the Faculty of Health Sciences
at the American University of Beirut

Beirut, Lebanon
January 2014

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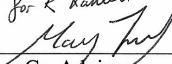
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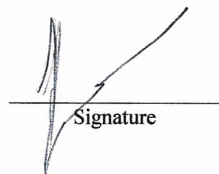
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CONTENTS

ACKNOWLEDGEMENT	V
ABSTRACT	VI
LIST OF TABLES	VII

Chapter	Page
I. BACKGROUND AND STATEMENT OF THE PROBLEM...	1
A. Background Information	1
B. Research Problem	3
C. Hypothesis	5
D. Objectives of the Study	5
II. LITERATURE REVIEW.....	6
A. Importance of Food Safety	6
B. Challenges Faced by Developing and Developed Countries	8
1. Food Safety Concerns in Developing Countries	8
a. Domestic Level	8
b. International Level	9
c. Indonesia Case Study	10
d. Africa Case Study	11
2. Food Safety Concerns in Developed Countries	11
a. Domestic Level	11
b. International Level	12

c. USA Case Study	13
C. Environmental Management Safety Tools	14
1. Good Manufacturing Practices	14
a. Facilities and Design	15
b. Supplier Control	19
c. Documentation and Record Keeping	19
d. Sanitation and Hygiene	20
e. Pest Control	22
f. Staff Training	23
2. Hazard Analysis and Critical Control Points.....	24
a. HACCP Guidelines and Principles	24
b. Implementation of HACCP Internationally	28
3. ISO 22000	29
a. Benefits of ISO 22000	30
b. Standards of ISO 22000	30
4. Global Barriers for Implementing GMPs and HACCP	31
a. Identifying Global Barriers	32
b. Canada Case Study	32
c. Turkey Case Study	33
III. METHODOLOGY	35

A. Study Design and Measures	35
B. Study Population and Sample	36
C. Research Instrument	37
D. Procedure	38
E. Data Analysis	40
IV. RESULTS.....	44
A. Size of the Industry	44
B. Geographical Distribution of Industries.....	46
C. Type of Industry	47
D. Familiarity of Food Safety Officers/ Managers about Food Safety Management Systems	47
E. Barriers	50
F. Benefits	57
G. Preferred Supportive Body to Implement Food Safety Management Systems.....	65
v. DISCUSSION	73
A. Barriers	74
1. Size of the Industries	74
2. Type of Industries	78
3. Location of Industries	79
B. Benefits	81
1. Size of Industries	81

2. Type of Industries	83
3. Location of Industries	84
C. Preferred Supportive Bodies	86
1. Size of Industries	86
2. Type of Industries	87
D. Training and Knowledge Assessment	88
VI. CONCLUSION AND RECOMMENDATIONS.....	94
APPENDIX.....	98
A. TABLES AND FIGURES.....	98
B. ADMINISTERED QUESTIONNAIRE-ENGLISH.....	102
C. ADMINISTERED QUESTIONNAIRE-ARABIC	109
REFERENCES	117

ACKNOWLEDGMENTS

It is without a doubt that this thesis project could not have been accomplished without the presence of several individuals who stood with me and gave me all the encouragement, support and perseverance to keep moving forward.

I cannot but thank my advisor, Dr. Rabih Kamleh, for his constant efforts and dedication to this thesis. He has helped me every step of the way with constructive criticism and on going encouragement.

Dr. Mey Jurdi's help cannot go unnoticed, with all her expertise and professionalism that had added value to this study. I thank her deeply.

As for Dr. Monique Chaaya, her efforts and time were of great importance, for she has given a lot to the analytical and statistical parts of this thesis, which enriched my project. I thank her for everything.

For those who don't know me, my family is my greatest pride. I have four unique, special and amazing individuals that make my world a better place.

Dad, you are such an inspiration of hard work, professionalism and perseverance. Your constant love and support mean the world to me.

Mom, I cannot think of a time where you weren't there for me. You are a person I look up to and turn to through everything. You are my rock.

Kareem, eventhough I am a year and a half older, but I truly believe you are my twin.

Seeing your accomplishments has given me a drive to complete my work.

Sam, as you are growing older I can see the man you are turning into which makes me so proud of you. Thank you for giving me the laughs when needed the most.

I love you all.

As for my friends, I am truly blessed to be surrounded by such a heart warming and driven group. You know who you are. I cannot imagine my journey without each and every single one of you. I love you all.

Special thanks to the Lebanese National Council for Scientific Research for funding this research project.

AN ABSTRACT OF THE THESIS OF

Lama El Chaar for Masters of Sciences
 Major: Environmental Sciences

This study identified the barriers and benefits that licensed Lebanese food industries face when implementing GMPs and HACCP. Barriers, benefits and certifying bodies were cross tabulated with size, location and type of industries to check whether these parameters have an impact on the food safety officer's choices. It was predicted that cost, resistance to change and lack of knowledge would be the barriers selected by the majority of the industries. However, the results show that cost was a major barrier selected by all industries, while resistance to change and lack of knowledge were of very low percentages. The size and type of industries affect the choices of barriers, benefits and certifying bodies, while the location is not a determining factor. The major barriers of implementing GMPs and HACCP in Lebanese food industries are the cost, lack of prerequisite programs, and poor infrastructure and facilities. Benefits of implementing GMPs and HACCP differed among large and small industries. As for a supportive and certifying body, an independent authority is of great favor to the Lebanese food industries. These results were compared to global case studies. The study also pointed out the absence of government commitment and support in Lebanon, while it is vitally needed for enforcement. It also shed light on the lack of staff involvement and training when wanting to adopt a food safety management system. Much awareness is needed, as well as financial support and training, to provide the Lebanese industries with the required conditions to adopt GMPs and HACCP as their food safety management systems.

LIST OF TABLES

Table 1..... Frequency Distribution of Industries by Selected Characters

Table 2.....Frequency Distribution of Study Population and Sample Group by
Region

Table 3..... Frequency Distribution of knowledge about GMPs and
HACCP by size of Industry

Table 4..... Percent reporting the specific barriers by size of industry

Table 5..... Frequency Distribution of Barriers by location

Table 6 Percent reporting the specific benefits by size of industry

Table 7 Percent reporting benefits by location of industry

Table 8..... Frequency Distribution of Barriers for Implementing Food
Safety Management Systems in Descending Order

Table 9..... Frequency Distribution of Benefits for Implementing Food
Safety Management Systems in Descending Order

Table 10..... Frequency Distribution of Familiarity of Food Safety Officer about
GMPs and HACCP

Table 11.....	Frequency Distribution of Familiarity of Food Safety Officer about the principles of HACCP and entities of GMP
Table 12.....	Knowledge about GMPs and HACCP in relation to the extent of knowledge about their principles
Figure 1	Frequency Distribution of Barriers by type of industry
Figure 2	Frequency Distribution of Benefits by type of industry
Figure 3	Frequency Distribution of Preferred Selected Bodies by size
Figure 4	Frequency Distribution of Preferred Selected Bodies by location
Figure 5	Frequency of Distribution of Preferred Selected Bodies by type of industry
Figure 6.....	Percentages of Correct Answers Concerning Familiarity of GMPs and HACCP from Highest to Lowest Percentage (Question 18 of Questionnaire)
Figure 7.....	Frequency Distribution of Preferred Selected Bodies to Help the Industries implement HACCP in Descending Order

CHAPTER ONE

BACKGROUND AND STATEMENT OF PROBLEM

In this chapter, background information on HACCP will be included; in addition to that, the research problem, hypothesis, objective and significance of this study will also be part of the first chapter.

A. Background Information

Foodborne illnesses have become major threats to public health (Fotopoulos et al, 2011). Specifically, they pose a major challenge to developing countries as they hinder progress and thrive to development (Fotopoulos et al, 2011). To promote food safety would be to assure that the food consumed will not cause harm to the consumer especially that recent reported global breakouts included major health risks relating to mad cow disease, dioxins in the food chain, pesticide residue in foods and other food safety issues (Fotopoulos et al, 2011).

To assure food safety, a management system known as Hazard Analysis and Critical Control Points or HACCP has been proposed for implementation since 1985 by the National Academy of Science in the USA. This food management system targets food safety through analyzing biological, chemical and physical hazards throughout the production chain (FDA, 2013). HACCP should be applied throughout the food chain from raw material production, handling, manufacturing, distribution and consumption (FDA,

2013). Analyzing the HACCP management system, there are some basic definitions that need to be adhered to. For example, hazards are defined as all agents of physical, chemical or biological nature that are capable of causing harm or illness if they are not controlled or eliminated (FDA, 2013). As for the critical control points (CCP), they are steps along the production chain where control of the identified hazards is necessary to prevent any illnesses or injuries from occurring by eliminating it or reducing it to an acceptable limit (FDA, 2013). These acceptable limits are called critical limits which determine maximum and minimal values of biological, physical and chemical hazards that need to be maintained or reduced at the CCPs to produce a final product that is safe for the consumer (FDA, 2013).

In order to apply the HACCP plan properly it is mandatory that the management at the industry or company shows great commitment and insures the provision of adequate financial and technical resources. This commitment needs to be handed down to the employees and to understand the importance of food safety and to properly define their roles in ensuring the quality of the final product. As HACCP should be applied at all segments of the food production process, employees should be properly trained to identify potential hazards. This is essential to sustain the proper implementation of this food safety management system and insure proper surveillance. Moreover, the commitment of the management will trigger the understanding of the benefits as well as the costs of implementing a food management system such as HACCP. Once these costs are identified, the management would be better prepared to organize tasks and work flow to overcome projected obstacles. Moreover, the identified benefits of implementing HACCP will

increase the overall sense of commitment at the work place and the quick response to onsite problems. As such, HACCP system is a strategy that teaches management on how to identify and mobilize resources. Consequently this will reduce part of the incurred cost and ensure food safety (FDA, 2013).

The production of safe foods requires foundations that will guide the HACCP plan through. These foundations are called prerequisite programs (FDA, 2013). These programs guarantee operational and environmental conditions that will help the implementation of the HACCP program throughout the production chain and steps (FDA, 2013). Some of these conditions are included in some federal or state regulations in the United States of America to force their application in the system; these conditions need to be evaluated and assessed once the HACCP plan is executed. In addition, prerequisite programs are managed separately than the HACCP program (FDA, 2013). This is because prerequisite programs are requested to support effective HACCP application. They need to be managed, maintained and, in some cases, standardized to ease the implementation of HACCP. Once these programs are being followed and maintained, the HACCP plan will be effective and operational in producing safe and wholesome food products that will not harm the consumer upon consumption (FDA, 2013).

B. Research Problem

Implementing HACCP and its prerequisite programs is a universal solution to guarantee food safety and quality assurance. However, countries of different regions, regimes and economic capacities face different barriers that affect the implementation of HACCP and its prerequisite programs (Fotopoulos et al, 2011).

Global barriers include the lack of knowledge of employees, cost of implementation, lack of commitment, resistance to change and others (Fotopoulos et al, 2011). These barriers have been identified through studies that target food industries all over the world, along with the challenges and barriers they face when adopting a food safety system (Fotopoulos et al, 2011).

As for Lebanon, quantifying its burden of disease associated with food poisoning is difficult because the symptoms that follow foodborne illnesses, such as diarrhea and vomiting, are not considered as serious threats, which lead to minimal reporting (Kamleh et al, 2012). Nevertheless, microbial studies that have been taking place showed that the Lebanese population is exposed to a wide range of microbial pathogens through different pathways. For example, *Brucella* spp. was a source of consuming unpasteurized dairy products (Kamleh et al, 2012). In 2009, studies done on Lebanese dairy products (Kishk, Shankleesh, unpasteurized cheeses) and on different meat pies found high levels of microbiological contamination (Kamleh et al, 2012). Different pathogens like *L. monocytogenes* and *Salmonella* were identified in different food products in Lebanon. As a result, there is a need to adopt a foodborne disease surveillance and inspection system as a food safety management strategy (Kamleh et al, 2012). The proposed food safety law in the country requests that food safety management systems should be coordinated within an independent food agency (Kamleh et al, 2012). However, such activities are awaiting the approval of the proposed food safety law as indicated before.

C. Hypothesis

More than 50% (the majority) of industries will identify cost, lack of knowledge and resistance to change as the most common barriers faced by the food safety officers that stop these licensed industries from adopting GMPs and HACCP.

D. Objectives of the Study

The main objectives of the study are:

1. Assess specific barriers (cost, lack of knowledge, resistance to change, technical difficulties, etc...) that refrain food industries from adopting GMPs and HACCP in their food safety system and then compare their distribution according to industries' related factors (size, location, type of food product , etc...) that impact the decision for executing HACCP.
2. Assess the knowledge and attitudes of food production/ safety officers about GMPs and HACCP.

CHAPTER TWO

LITERATURE REVIEW

A. Importance of Food safety

Food safety is of major importance to reduce on exposure to potential hazards and protect the health of consumers. Food safety is defined as the absence of contaminants, or their presence in acceptable levels, so that they do not impact health (FAO, 2010).

To assess food safety, the World Health Organization (WHO) developed the concept of “burden of disease” (WHO, 2004). Burden of disease “describes death and loss of health due to diseases, injuries and risk factors for all regions of the world” (WHO, 2004). However, the burden and cost of unsafe foods is undefined still. Furthermore, the global information is not consistent and the profile of foodborne diseases is still not clear (WHO, 2004). For example, diarrheal diseases kill almost two million children every year (WHO, 2004). But, the total burden of diseases is not yet assembled which makes the data incomplete (WHO, 2004). The heaviest burden of diseases happens in developing countries where it affects national and international development (WHO, 2004).

The importance of food safety has been on the rise mostly due to scientific developments documenting its importance and significance. This information is now more accessible to the public that is becoming more concerned (FAO, 2010). For example,

pesticide residues are a serious concern that has been studied and fully documented by the Environmental Protection Agency (EPA, 2013). The EPA has set guidelines and tolerance levels, along with a thorough discussion on the possible hazards it causes, especially to children (EPA, 2013). In addition, the law has given EPA full authority to “request tests and information on estrogenic effects for all pesticide chemical residues” (EPA, 2013). Moreover, the Joint FAO/WHO Expert Committee on Food Additives (JECFA) is another trial of efforts to monitor food safety. JECFA is a collaborated committee between the FAO and the WHO, for the purpose of evaluating the safety of food additives (WHO, 2013). Since the year of 1956, JECFA has evaluated more than “2600 food additives, about 50 contaminants and naturally occurring toxicants, and residues of approximately 95 veterinary drugs” (WHO, 2013). Above all that, JEFCA has also been responsible for safety assessments of chemicals in food and developing new risk assessment procedures, through toxicology and other sciences (WHO, 2013). On the other hand, consumers in developing and developed countries have become more aware of food safety issues (FAO, 2010). Not only imported goods are of major concern to consumers but also those of domestic production. As such, food industries are seeking international food safety management system certification to ensure the production of safe products from farm to fork (FAO, 2010).

In addition to the public health concerns, food safety poses as an economic challenge. The value of crops and animal products destroyed or ruined due to poor food safety management practices bring forth several consequences. For instance, medical treatment costs, morbidity and mortality rates rising and rejection/detention values in

export trade are all significant consequences that are likely to occur when the product does not meet the international standards (FAO, 2010).

B. Challenges Faced by Developing and Developed Countries

It is now clear that food quality and safety play a vital role in the market because consumers need to trust the product they are purchasing (Promotional Feature, 2011). Food manufacturers who don't ensure the quality and safety (physical, chemical and microbiological) of their products will eventually lose their place in local and export markets (Promotional Feature, 2011). Furthermore, the challenges faced in developing countries concerning food safety and quality assurance vary from the ones faced in developed countries due to the various factors.

1. Food safety concerns in developing countries.

Developing countries have two situations that they need to consider; the domestic food safety burden and the international food safety problems (Hariyadi, 2011). The domestic problem is when the developing country needs to integrate food safety into its infrastructure and domestic food safety system (Hariyadi, 2011). The international problem lies in the compliance with international standards that will facilitate the trade of the product in export markets (Hariyadi, 2011).

a. Domestic level

The burden of disease in developing countries is directly correlated to inadequate food safety (World Bank, 2013). Over 70% of the deaths related to food contamination are caused by biological contaminants, especially mycotoxins and foodborne parasites (World

Bank, 2013). Food safety is clearly an important factor to protect public health, and in return decrease rural poverty (World Bank, 2013). In addition, rapid urbanization is taking its toll in developing countries, along with the increased influx of people to urban areas (World Bank, 2013). Thus, food safety becomes even more challenging and difficult to handle without the sufficient public capacity (World Bank, 2013). Developing countries are in need of interventions that include proper risk analysis (assessment, management and communication). However, most risk management strategies are politically directed and therefore might cause some public outrage, especially when the policies are assigned and ready to be implemented (World Bank, 2013). Another challenge faced on the domestic level is that food safety will also enhance “sanitation, water supply and nutrition” (World Bank, 2013). The burden of disease in developing countries is mainly a factor of all three, so eliminating hazards from one of these sources may or may not decrease risk to the consumer (World Bank, 2013). To address this issue, public interventions are needed, but as mentioned before, the public capacity is highly limited. The government in developing country does not have the technical staff to address such issue or at least develop a plan for intervention. The government is also torn between domestic market control and economic benefits (World Bank, 2013).

b. International level

At the international level, it is important to note that more than 40% of trade happens between developing and developed countries (Hariyadi, 2011). Developing countries need to make sure that the products exported are in compliance with international standards to insure sustainability of the trade. On the other hand, if the developing countries

cannot meet the requirements and standards of developed countries, this leads to limited market access and huge export/income losses (Hariyadi, 2011).

c. Indonesia case study

Indonesia reported 197 foodborne disease outbreaks and 8,943 reported cases of morbidity in 2008 (Hariyadi, 2011). In 2009, Indonesia 119 outbreaks and 3,050 cases of morbidity were reported (Hariyadi, 2011). The majority (more than 40%) of the reported foodborne illnesses was caused by home-made food, while the second major source (above 20%) was related to food industries (Hariyadi, 2011). Moreover, the most significant type of risk (36.7%) in 2009 was microbiological contamination (Hariyadi, 2011). Relating to the sources of the foodborne diseases, it become clear that the underlying causes were the unsanitary conditions at home and in industries. As a result, the roots of the problem are a combination of poverty, dominance of small to medium sized establishments and lack of basic safety infrastructure and funding. Poverty limits the accessibility of food in Indonesia (Hariyadi, 2011). In addition, small to medium sized establishments consider food safety management systems as an additional cost (Hariyadi, 2011). As for the existing environmental infrastructure, clean water, clean ice and solid waste management are all absent in Indonesia (Hariyadi, 2011). Moreover, availability of technical resources is minimal and governmental control is highly deficient (Hariyadi, 2011). This underscores the significance of food safety and the importance of quality control. Moreover, Indonesia does not have the financial resources to support such food safety management systems on the domestic and industrial level (Hariyadi, 2011).

Internationally, the trade of fish and meat faced major losses between 2002 and 2009 due to trade rejections (Hariyadi, 2011). The EU rejected products mostly from Indonesia due to the detection of heavy metals, veterinary drug residues and biotoxins (UNIDO, 2010). USA also rejected Indonesian products due to microbiological contamination, veterinary drug residues and the unsanitary conditions of products (UNIDO, 2010).

d. Africa case study

Other than Indonesia, African countries face their own challenges of food safety. For instance, African countries have small industries unable of implementing safety measures (Promotional Feature, 2011). Absence of cleanliness and sanitation are major challenges that pose a high risk of food contamination, in addition to the inconsistent water quality that is used for food production and cleaning and sanitizing of equipment and working surfaces (Promotional Feature, 2011). Moreover, most African countries do not have a system for reporting food complaints nor for tracing cases of foodborne diseases (Promotional Feature, 2011).

2. Food safety concerns in developed countries.

a. Domestic level

Nationally, all developed countries face in general two main food safety concerns; antibiotic resistance and genetically engineered foods (De Waal & Robert, 2005). Antibiotic resistance resulted from the uncontrolled use of high doses of antibiotics (De Waal & Robert, 2005). And, the main food products that were injected with antibiotics are food-producing animals and poultry (De Waal & Robert, 2005). However, it is important to

note that antibiotic resistance is also an issue in developing countries, but its impact is one of two major concerns in developed countries. Thus, antibiotic resistance is discussed under the food safety concerns of developed countries. As for the genetically engineered foods (GE), several concerns relating to allergic reactions, impact of pesticidal traits and the traceability of GE organisms have been addressed (De Waal & Robert, 2005). Other challenges that developed countries face on a local level, are lack of hygiene throughout the food process chain, excessive storage time and cross contamination (De Waal & Robert, 2005). Furthermore, the incidence of foodborne illnesses is very high given that control measures are implemented. Toxic industrial and agricultural contaminants have been detected in more than one product and especially in fish and other marine food products (De Waal & Robert, 2005).

b. International level

The challenge starts at the local level and is then dispersed into global markets; it is the concept of bioterrorism (De Waal & Robert, 2005). This is the case where foods are contaminated intentionally to serve a specific purpose. This is critical, and even agencies like the US FDA and USDA need lots of resources to respond to such activities as mostly they do lack the required authority and recall powers (De Waal & Robert, 2005).

Furthermore, expanding the world's economy has given rise to food trade, consumer demand and improvements in transport and communication (FAO/WHO, n.d). The access of countries to export markets depends on the quality of the products they trade (FAO/WHO, n.d). Developed countries in comparison to developing countries are more capable of sustaining the quality requirements for trade. As a result, developed countries

are prone to reject imports from developing countries, which will in return limit access to export markets (FAO/WHO, n.d).

c. USA case study

It has been estimated that over 33 million individuals suffer from foodborne illnesses a year and nine thousand people die annually from severe cases (University of Rhode Island, 2013). In addition to that medical bills, insurance claims and wage loss costs add up to total an amount between 7.7 and 23 billion USD (University of Rhode Island, 2013). As a result, food safety is a concern that is constantly highlighted in the media (University of Rhode Island, 2013).

At present, several incidents have stressed the importance of food safety in the United States. The first is the antibiotic resistance, which increases the probability of survival of pathogenic microorganisms and the exposure to foodborne illnesses (University of Rhode Island, 2013). The second is the change in consumers' demographics, where the elderly shape up a huge percentage of the population, and immune-deficient individuals are increasing in number (University of Rhode Island, 2013). As such the risk of exposure increases.

The third issue relates to the change in the lifestyles of the consumers that involves an increase in "labor-saving equipment" for food handling such as microwaves and food processors. Moreover, lack of knowledge about the basic food safety principles and minimal dependence of home prepared food are very common and increase the risk of exposure to foodborne illnesses.

Moreover, USA and for the past ten years has depended heavily on imported goods (News Desk, 2012). The Government Accountability Office (GAO) has reported that a lot of work needs to be done on behalf of the U.S. Food and Drug Administration (FDA) to improve monitoring and inspection of all imported goods (News Desk, 2012). According to FDA, very few countries meet the standards set by FDA relating to food quality assurance; this makes it hard for the United States to accept imports as much as they used to (News Desk, 2012). At present, FDA cannot afford the resources to examine all trade products since the import and export market is huge. For example, in 2011, the FDA was able to inspect 2.2 percent of all entry lines (News Desk, 2012). As a result, foodborne illnesses and absence of food safety and quality assurance are still major challenges in a developed country like the United States of America.

C. Environmental Management Safety Tools

Food safety is a global concern that affects both, consumers and businesses. A food safety management tool is a framework that defines food safety responsibilities, as well as the possible risks and hazards that may occur throughout the production chain. The most significant food safety systems are Good Manufacturing Practices, Hazard Analysis and Critical Control Points and ISO 22000.

1. Good manufacturing practices

The first prerequisite program is Good Management Practices (GMPs). The World Health Organization (1997) defines GMPs as “that part of quality assurance which ensures that products are consistently produced and controlled to the quality standards appropriate

to their intended use and as required by the marketing authorization”. GMPs are mostly applied as part of the series of guidelines to implement a HACCP plan.

a. Facilities and design

GMPs include looking at the facilities and following certain sanitary design principles (FDA, 2012). It also includes the location of the establishment, where residential areas and locations of solid waste disposal should not be in the neighborhood (Dyson, 2011). Moreover, the size of the establishment is supposed to be of the right size depending on the type of production process, number of products produced and number of employees needed. As for the sanitary design that has been mentioned before, floors, walls, ceiling ventilation and lighting all play an important role to satisfy that design (Dyson, 2011). The layout design of a food plant should prevent/reduce the transfer of microbiological, chemical and physical hazards from the environment of production or storage to the food products. The floors, ceilings and walls must be kept away from food, food contact surfaces and food packaging material (Dyson, 2011). So, the material chosen to design and construct these surfaces must not form cracks or scars when being cleaned using normal detergents or special sanitizers. Cracks store water and microbes that will in turn attract pests and insects. This will eventually lead to the contamination of food products.

Moreover, another detail that requires full attention is the area where the floors meet with walls. This corner can be a bit circular and not too edgy or simply have a waterproof seal to prevent the accumulation of food debris and dirty water. Once these accumulate, they will become a niche for microorganisms that may also contaminate the food products. (Dyson, 2011)

In addition, the material used for the walls, ceilings and floors and their conditions need to be evaluated. A program of preventive maintenance should be implemented in the plant to prevent food contamination (Dyson, 2011).

Still, the sanitary design is not complete without the proper infrastructure that holds the facility together. For example, pipes, ducts, coolers and overhead fixtures are to be constructed and fixated in optimal conditions. Dripping water or condensate are true hazards to food products, food contact surfaces and food packaging materials. This is due to the water and moisture that encourage bacteria and mold growth, which would then contaminate the food product. To prevent such hazards it is important to control humidity in order to avoid condensation. Thus, temperature control and air circulation are possible solutions that will prevent such condensations on the ceilings, floors and pipes (Dyson, 2011).

Furthermore, ventilation in the facility is a requirement to control humidity, odors and vapor in places where they can contaminate food. To support the ventilation system, air-blowing equipment and fans can be located to minimize such vapors and odors to ensure a positive air flow mainly in the production and packaging area. Improper ventilation can be a source of contamination as well. That is why evaluating the air quality and the movement of the air is essential. The purpose of applying ventilation is to prevent heat, steam, condensation and dust to form and accumulate. Taking into consideration the workers in the facility, controlling heat and steam, as well as odors, will enhance their comfort, which in turn will improve their productivity (Dyson, 2011).

Different factors should be taken in consideration regarding the implementation of an effective ventilation system. For example, positive air pressure zones are an effective strategy followed when designing food-processing plants. Don Graham (2011) stated, “The air pressure zone with the highest positive pressure should be the area where the product is last exposed to open air”. This means that if the food production process includes killing an animal, such as a cow or chicken, then the air pressure zone is the area where the packaging and sealing of the final product takes place (Graham, 2011). On the other hand, if the production process does not include a kill, then the air pressure zone includes all areas from the washing to the packaging (Graham, 2011).

Furthermore, adequate lighting is important for so many reasons that include worker comfort, better inspection and improved hygiene; accidents can happen, and one of the major physical hazards is glass breakage. As such, proper lighting would prevent food contamination. Lamps and light bulbs should be covered or held in a manner where glass shatters stay away from food contact surfaces or the food itself (Dyson, 2011)

Moreover, protecting food products should be attained by covering them properly or storing them away from the work environment

Aside from the facility design, it is important to look out for its layout. Aisles and walking spaces need to be taken in consideration between the equipment and walls. Adequate spaces to walk around without any obstruction and cross-contamination should be ensured for the employees and staff to work comfortably and efficiently. Contamination is controlled through avoiding the workers from getting in contact with food contact surfaces, whether

through direct contact or through their work clothes. In addition, in the case of work stations, employees need their personal space in order to work efficiently and not suffer from congestion or crowdedness. Moreover, the separation of raw material from the final product is mandatory to prevent cross-contamination from taking place. The optimal way in doing so is by having the raw material enter from one end of the facility and the final product dispatched from another. To organize the process, upon receiving the raw material, the production process moves in a linear direction until it is ready for distribution. This would reduce the retracing of the workers' steps and movements which will in turn decrease the chances of contamination incidences.

Furthermore, to maintain this recommended layout, it is important to evaluate the placement of the equipment, the direction of the processing lines and spacing of work stations. After the evaluation, modifying and changing of the placements and the process lines can take place for more efficient activity and sanitary production. Finally the work flow should be clearly defined to avoid cross contamination.

The last facility requirement is the waste disposal services. The most common type of waste generated is organic waste. Proper handling and storage is critical to control pest infestation. Finally, to insure the proper implementation GMPs requirements monitoring needs to be instated to sustain the conditions of the facility infrastructure and design (Dyson, 2011)

b. Supplier control

Another important entity that constitutes the prerequisite programs of GMP is supplier control. The importance of supplier control goes back to fulfilling the motivation of building a good and successful business (Lee, 2000). In other words, a good business is one that relies on good quality from the source and throughout production. Choosing suppliers carefully and meticulously will prevent the occurrences of quality risks (Lee, 2000). These quality risks from the supplier stage are divided into four levels. In ascending order, the levels are classified as negligible quality risk, minor quality risk, major quality risk, and finally critical quality risks (Lee, 2000). These levels are in general measured according to the possible hazards that might occur to the targeted population that will consume the final product (Lee, 2000). It is also recommended that a contract or agreement is signed between the suppliers and the producers. This contract would ensure the producers involvement in the auditing, monitoring and delivery activities (Lee, 2000). In addition, the producers should develop plans for proper risk management and improved performance (Lee, 2000). It is important to note that producers must learn to trust their suppliers; however, verification is always needed (Lee, 2000)

c. Documentation and record keeping

Documentation is an important component of GMPs; documentation of specifications and procedures that would detail the quality of incoming material, production process and final product (WHO, 1997). This type of documentation is a summation of validation studies, stability studies and even safety studies. Manufacturing instructions are

also part of this documentation package. Once put altogether, this list of documents would help the producers describe specific instructions that need to be followed in every procedure (WHO, 1997). Another form of documentation is the recording of data and that takes place throughout the production process to monitor the performance and evaluate the quality of the product (WHO, 1997).

Additionally, the use of identification numbers should be implemented (WHO, 1997). These consist of operation numbers, equipment numbers or batch numbers. The batch/lot numbers serve for the purpose of tracking and retrieval of the final product and then identify the supplier. This would help decrease and reduce the occurrences of risks and hazards to the consumers. In addition, it would protect the business and producers from market rejection (WHO, 1997). One more type of documentation is the labeling (WHO, 1997). This is where “status of the equipment or facility, restricted areas, and warning labels” are used in order to keep the employees and workers alert all times during the production process (WHO, 1997). This documentation system must be checked regularly and evaluated in order to pick up the gaps and eliminate the unnecessary entities. Changes and revisions would give great input and efficiency in the work place. (WHO, 1997)

d. Sanitation and hygiene

Another important section of the prerequisite program is the provision of sanitation services and promoting the personal hygiene of the employees. This section includes the premises and the personnel (WHO, 2006). Personal hygiene should begin with health examinations that are done before and during employment (WHO, 2006). These

examinations are either physical (eye examinations and visual inspection) or hygiene training (personal hygiene practices and written instructions) (WHO, 2006). Posting signs all over the premises to help the employees remember the procedures is a very helpful technique (WHO, 2006). These signs are to be posted in the changing rooms, before entering the production areas, and in the toilets. Another issue that concerns sanitation is when the employee suffers from an illness or open lesions. The employee who is diagnosed with either of the two must stay away from the handling of foods and materials or even the final products. In other words, anyone with lesions or is sick are not to touch or be close to packaging materials, starting materials and bulk products (WHO, 2006). As such monitoring of hygiene and employees health will protect the food product (WHO, 2006). Furthermore, the contaminating agent is not the employee alone, but the clothes, hair and hands. So the clothes need to be cleaned and appropriate for personnel activities and stored separate from the clothes that are worn outside the premises (WHO, 2006). As a result, all individuals that enter the production areas are required to wear protective clothing, which include hair caps and gloves when needed. These individuals can be employees, visitors, managers and inspectors (WHO, 2006). In addition to that, when the clothes need to be disinfected or sterilized, an appropriate facility is required to do the job properly (WHO, 2006). Moreover, hygiene principles forbid smoking, eating and drinking in production areas, storage areas and laboratories. Cafeterias and refreshment areas need to be separated from the areas listed above (WHO, 2006). Moreover, the toilets and that they don't open directly into production and storage areas (WHO, 2006).

e. Pest control

Pest infestation of the facility can additionally pose important threat to food safety. Pests include mammals, birds, insects and reptiles (Fishernut, 2012). Hence, it is important to establish a pest control system to avoid food hazards and contamination and to guide the employees on how to handle such problems. This program would assign all the areas that might get affected by such rodents, reptiles or insects; thus needing constant monitoring (Fishernut, 2012). In addition to that, the treated areas must also be part of the program so that effectiveness of this pest control system is evaluated and monitored (Fishernut, 2012). Additionally, proper directions should be provided for example, the distances where the traps are placed, the schematic maps prepared, numbering of stations, and the timings and dates of the traps that have either been placed or checked (Fishernut, 2012). It is important to note that the catching and disappearance of baits must also be recorded and documented using pest control logs (Fishernut, 2012).

Additionally, the conditions of the floors and the storage and management of garbage has to be properly addressed to minimize pest attractions (Fishernut, 2012). For example the grass lawns surrounding the facility should be cut short at all times so that rodents and reptiles do not hide between them and access the industry unnoticed (Fishernut, 2012).

Moreover, one of the most important tasks that should not be taken lightly is proper housekeeping; daily cleaning and sanitizing is necessary in the high and medium risk areas mainly where packaging, storage and handling is done (Fishernut, 2012). Also, surface

drainage must be practiced to avoid pest breeding and food contamination incidents (Fishernut, 2012). Additional activities relate to ensuring the water quality and the condition of disposal systems. For instance, water treatment is advisable and inspection of the conditions of nearby areas of the plant that are not in the industry's control is recommended as well (Fishernut, 2012).

f. Staff training

Training of the staff is necessary, and their involvement with the internal management is also important (COCERAL/COGECA, 2010). All staff members must be aware of hygiene practices and should attend regular orient sessions to refresh their knowledge. Furthermore, helping the staff understand the role of employees in causing contamination or inflicting cross-contamination stresses the importance of adhering to hygiene and food safety requirements (COCERAL/COGECA, 2010). Additionally, instructions for compliance in the shape of signs or warnings can be hung in visible places around the premise, as well as maintenance and cleaning schedules (COCERAL/COGECA, 2010). Smoking inside the work place and in the storage area must be forbidden. Designated smoking areas should be assigned either outside or away from handling, storage and other restricted areas (COCERAL/COGECA, 2010).

Moreover, implementing hygienic requirements should not be limited to fulltime staff only but should include all people entering food preparation areas. For instance, when visitors arrive at the food industry, they need to be introduced to the rules and hygiene

practices followed. In turn, they will have to implement these rules upon stepping into the industry (COCERAL/COGECA, 2010).

2. Hazard analysis and critical control points

Hazard Analysis and Critical Control Points (HACCP) is a system that is adopted to control biological, chemical and physical food hazards along the chain of raw material production, handling, to manufacturing, distribution and consumption of the finished product (Food and Agriculture Organization/ World Health Organization, 2007). HACCP has been established twenty years ago and its importance has been rising nationally and internationally over the years (Food and Agriculture Organization/ World Health Organization, 2007). However, before implementing HACCP, it is crucial to implement the prerequisite programs, such as the GMPs as presented above. Aside from the importance of HACCP in ensuring food safety, it has become a system that unites international markets and serves as a requirement for the trade to take place (Food and Agriculture Organization/ World Health Organization, 2007). Applying HACCP in a food industry or facility is not enough; the successful implementation is what is needed. To ensure food safety, the involvement and commitment of the management and the employees is essential (FAO, 2012). Moreover, HACCP is compatible with the application of ISO 9001, and Total Quality Management (TQM) and follows twelve guidelines, seven of which basic HACCP principles (FAO, 2012).

a. HACCP guidelines and principles

The first guideline relates to assembling of the HACCP team; specific knowledge and expertise are needed to address the food hazards that are of concern during the production of this specific product (FAO, 2012). HACCP is a multidisciplinary approach, so the team of experts should follow the nature of this food safety system; the team must be diverse specialization to be able to identify all types of hazards that pose a threat to the quality and safety of the food produced (FAO, 2012).

The second guideline relates to the description of the product; this is where the composition of the product, along with durability and storage conditions, has to be addressed (FAO, 2012). The pH and water activity are important physical/chemical characteristics that are also included in the description of the product. Another important aspect is the type and methods of packaging to ensure the product's safety and quality assurance (FAO, 2012)

The third guideline relates to the identification of the product intended use; vulnerability of the target group is critical (FAO, 2012). Babies, pregnant women and elderly individuals are all categorized as vulnerable populations. Other individuals might also have health problems that prohibit them from consuming certain food types or ingredients (FAO, 2012).

The fourth guideline relates to the construction of a flow diagram; this task is given to the HACCP team that has been mentioned above. It consists of all the steps of the food production operation (FAO, 2012). The flow diagram shows all the steps before and after the current operation that is taking place (FAO, 2012). A detailed flow diagram will allow a proper control and elimination/ reduction of hazards

The fifth guideline relates to the onsite verification of the flow diagram; this takes place when the HACCP team monitors the line of operation and compares it to the flow diagram. Every stage and every hour of the operation, the HACCP team needs to make sure everything is as the flow diagram presents. If not, the diagram needs amendment or adjustment to represent the sequence of operations (FAO, 2012).

The sixth guideline, which is also the first principle of the seven principles of HACCP, relates to the identification and analysis of potential hazards, from “primary production, processing, manufacture, and distribution until the point of consumption” (FAO, 2012). After identifying these hazards, an analysis is conducted by the HACCP team where quantitative and qualitative evaluations of the possible hazards and the severity on the consumer’s health are taken in consideration. Furthermore, the survival and multiplication of microorganisms as well as traces of toxins, physical or chemical agents, are all part of the hazard analysis that builds up the first principle of HACCP. Proper control measures must be planned and considered for the identified hazards in the risk analysis exercise (FAO, 2012)

The seventh guideline, which constitutes the second principle of HACCP, relates to the identification of the critical control points; critical control points are not limited to one stage in a production operation. That is why it is crucial to identify all CCPs; a decision tree is normally used to facilitate the process. The decision tree should be easy to read and flexible to cover the different stages of food production operations (FAO, 2012). And, training in identifying CCPs is recommended (FAO, 2012).

The eighth guideline and third principle of HACCP relates to the establishment of the critical limits for each of the CCPs; critical limits are optimal levels that define a range that must not be exceeded to maintain food safety and prevent hazards from occurring (FDA, 2013). Various factors should be monitored and controlled to keep levels within these critical limits. These factors are temperature, moisture, water activity, pH and other parameters that include texture and appearance (FAO, 2012).

The ninth guideline and at the same time the fourth HACCP principle relates to the establishment of a monitoring system for each CCP; monitoring is a parallel act between the critical control point and the critical limits that have been assigned to it. When CCPs failures are detected, process adjustments and amendments must take place instantly. The more rapid the changes, the better because it will ensure that changes and deviations in the route of operation has not taken place (FAO, 2012). One designated person must be responsible for the monitoring procedure and he must have the knowledge and authority to carry it through and in a consistent pattern (FAO, 2012). Due to the delicacy of the situation and the little amount given to correct the problem, physical and chemical tests are preferred; rather than biological tests (FAO, 2012).

The tenth guideline, and also the fifth principle of HACCP, relates to the proposition of corrective actions; once monitoring detects a deviation, a rapid and on-the-spot solution must be ready for execution (FAO, 2012). These corrective actions must be effective concerning outcome and time. The critical limits must be maintained and the critical control point must be under control (FAO, 2012). The incidence should be recorded and documented for further evaluation (FAO, 2012).

The eleventh guideline which describes the sixth HACCP principle is establishing verification procedures; verification is a series of sampling and analysis through random auditing and tests to assure the HACCP team that the HACCP plan is effective (FAO, 2012). These verification procedures include a review of the records and documents, evaluation of the deviations experienced and valid confirmation that the CCPs are controlled (FAO, 2012). The frequency of such activities must be sufficient and satisfactory to verify the efficiency of the HACCP system.

The last guideline and last principle of HACCP is establishing documentation and record keeping; the documentation procedure needs to be adequate and appropriate and comprehensive (FAO, 2012). It should include all principles preceding this step. All types of data on hazard analysis, determination of critical control points and critical limits, monitoring activities, deviation accidents, and corrective actions should be included in the records of the HACCP plan. Additionally if the HACCP plan itself undergoes modification and adjustments, these changes must be recorded and documented in the records (FAO, 2012).

b. Implementation of HACCP internationally

Globally, hazard analysis of critical control points (HACCP) is considered as an effective approach that is also cost effective on the long run (Herath & Henson, 2010). It has been adopted by the United States as a food safety regulation covering seafood, poultry, meat and fruit juices (Herath and Henson, 2010). In Europe, the European Union has integrated HACCP beyond the primary food production of the food supply chain (Herath

and Henson, 2010). While, in the United Kingdom HACCP was adopted as part of the food quality and management system since 1995 (Gilling et al, 2001). In Canada HACCP was introduced in 1991 by the Canadian Food Inspection Agency became mandatory to apply in all food establishments by 2005 (Herath and Henson, 2010).

As for the Arab Region many countries have been working on enforcing quality control and implementing comprehensive food legislations (Kamleh et al, 2012). In Lebanon, for example, the proposed food safety law recommends the implementation of food safety management systems (Kamleh et al, 2012). And, the recommended systems are good manufacturing practices (GMP), HACCP, good hygiene practices (GHP), risk analysis and traceability (Kamleh et al, 2012). However, due to the unstable political situation, the proposed law is still pending approval and execution (Kamleh et al, 2012). As for the Gulf Cooperation Council (GCC), that have been experiencing growth in visitors, whether in Dubai and Qatar for tourism or in Saudi Arabia for al Hajj (Food Regulation Middle East, 2012) food safety has become a of major importance . As such, the GCC are working on developing an “efficient food control infrastructure” (Food Regulation Middle East, 2012). However, some of the challenges faced, especially that the GCC, developing a single common market to facilitate trade and fortify the GCC union (Food Regulation Middle East, 2012). As such, the Global Agriculture Information Network (GAIN) of the USDA Foreign Agricultural Service is trying to help GCC overcome the challenges and develop efficient food control strategies (Food Regulation Middle East, 2012).

3. ISO 22000

Globally, food industries and suppliers are under a lot of pressure to meet the standards and requirements of consumers and buyers (Færgemand et al, 2011). However, the burden of the overall cost of implementing food safety management systems and rigid requirements discourage industries from acquiring food quality and safety certification. In turn, food safety is not achieved or improved (Færgemand et al, 2011). As a result to these concerns, ISO 22000 was founded as a universal and recognized standard (Færgemand et al, 2011).

a. Benefits of ISO 22000

The global food market takes great interest in ISO 22000 so that importers and exporters rely on the same, universal standard for all parties (Færgemand et al, 2011). In other cases, food business operators have also taken great interest in ISO 22000 so that they can enter the global market in the near future (Færgemand et al, 2011). In addition to that, the ISO 22000 is also applicable across the food chain where it develops “principles, procedures and guidelines which match the food chain while improving cost-effective management in industry” (Færgemand et al, 2011). Managing food safety as a whole and coherent system is the main objective behind ISO 22000.

b. Standards of ISO 22000

The ISO 22000 includes five standards. These standards tackle different aspects of food safety. For example, ISO 22000:2005 is a list of standards on food safety management systems and their requirements for any organization in the food chain (Færgemand et al, 2011). The second standard is ISO 22002. This standard includes several entities that

elaborate on different prerequisite programs for manufacturing, catering and farming (Færgemand et al, 2011). The third standard is 22003:2007 which is a standard for food safety management systems and the requirements for bodies providing audit and certification of food safety management systems (Færgemand et al, 2011). The fourth standard is the 22004:2005 that is a standard for food safety management systems and its guidance on the application of ISO 22000-2005 (Færgemand et al, 2011). The fifth and last standard under ISO 22000 is 22005:2007, which is the standard for traceability in the feed and food chain- general principles and basic requirements for system design and implementation (Færgemand et al, 2011). On January first of the year 2011, it has been reported that 162 countries are members of the ISO certification; Lebanon is enlisted as a member body (Færgemand et al, 2011)

4. Global Barriers for Implementing GMPs and HACCP

Even though GMPs and HACCP have become mandatory by law in several countries; it is evident that some food industries are still reluctant to apply this food safety system. The reasons for not implementing GMPs and HACCP are various and cannot be identified solely by the unwillingness of the industries and their safety officers (Fotopoulos et al, 2011). A global study by Fotopoulos et al (2011) identified various “internal” and “external” barriers. In another study, the FAO and WHO (2007) defined internal barriers as those that are related to “legal requirements, basic infrastructure, level of economic development and political drivers” (Food and Agriculture Organization/ World Health Organization, 2007). On the other hand, external barriers include “export requirements, legal requirements, or state help” (Food and Agriculture Organization/ World Health

Organization, 2007). Additionally, various studies have also identified global barriers that affect the implementation of the GMPs and HACCP.

a. Identifying global barriers

Studies by Jevsnick et al (2008) and Bas et al (2007) found that the lack of training of employees and their insufficient knowledge about the food safety system are important factors that discourage the implementation of GMPs and HACPP. In addition, lack of expertise, interest and motivation are all extra barriers that make up global barriers. Other studies found that low commitment and limited resources restrain the industries from adopting GMPs and HACCP (Violaris et al 2008). Additionally, the company size, product and infrastructure, turn-over rate of employees, absence of technology needed, and the employees' resistance to change were also identified as limiting factors (Fotopoulos et al, 2011). Furthermore, considering HACCP as an economic burden is a major reason that food industries refrain from applying it (Ball et al, 2009). The training, monitoring and changes needed to implement HACCP principles can be also costly on the short term (Ball et al, 2009). On the other hand, other than global barriers, specific barriers that occur within a country or region were also identified.

b. Canada case study

Canada has made the adoption of GMPs and HACCP obligatory since 2005 (Herath & Henson, 2010). According to Herath and Henson (2010), "implementation is limited and food operators are not embracing this system", where employees and their officers are unwilling to apply the changes needed to comply with HACCP. Results of a meta-analysis

that included twelve studies identified several specific barriers. Once identified, these barriers were categorized in four “principle components” (Herath & Henson, 2010). The first category of barriers is “uncertainty of employees about potential benefits from HACCP” (Herath & Henson, 2010). This reflects the attitude of the employees and safety officers where they see that the present food safety systems are sufficient and that HACCP will change the flow of operation and reduce flexibility at the job (Herath & Henson, 2010). The second category of barriers addresses the scope of change that needs to happen at the industry or company to abide by HACCP, such as wide-scale facility upgrading (Herath & Henson, 2010). This change discourages the companies and facilities to adopt GMPs and HACCP because they are overwhelmed by the changes that will take place. The third category reflects on the lack of importance given to food safety investments because it is not considered a priority (Herath & Henson, 2010). This is where other issues that the facility deals with are given higher priority, and HACCP is put on hold. The final category is the cost of implementing HACCP and the difficulty of attaining external funding or providing an internal budget for applying the new food safety management system (Herath & Henson, 2010).

c. Turkey case study

Due to the importance of HACCP as a food safety and quality assurance system, other countries administered studies to identify the barriers and challenges faced by the food industries to apply GMPs and HACCP. However, it is important to note that barriers differ from country to country or from region to region. In Turkey, the results of a study that targeted 115 food businesses showed that only eighteen were implementing HACCP (Bas

et al, 2007). The barriers that were identified related to the time needed for HACCP implementation and lack of financial resources, along with lack of knowledge, inadequate resources and the lack of prerequisite programs, such as GMPs (Bas et al, 2007). Another issue faced in Turkish food industries is the lack of awareness workers have about the importance of food safety. As a result, the managers or food safety officers cannot force these workers to comply with a certain food safety system (Bas et al, 2007). Other barriers relating to lack of employee training, weak resource management, and unwillingness of employees to take certification examinations were also identified (Bas et al, 2007).

CHAPTER THREE

METHODOLOGY

In this chapter, the methodology of the research study will be divided into four sections, which are: study design and variables, study population and sample, research instrument, procedure and data analysis.

A. Study Design and Measures

It is a cross-sectional study that targets the barriers that the food industries in Lebanon face when implementing GMPs and HACCP as part of their food safety system. These barriers are identified as a function of size of industry, nature of production produced, and location of the industry. Thus, this cross-sectional study will identify the hazards that are most common in Lebanon and then compare their distribution as a function of different industry factors.

The main variables of this study are the barriers of implementing GMPs and HACCP. The specific barriers were drawn from the literature; namely lack of prerequisite programs, inadequate infrastructure and facilities, lack of awareness and expertise of staff, education and training of staff, technical support, cost, resistance to change, government infrastructure and commitment, and excessive paperwork and documentation; benefits of implementing GMPs and HACCP, namely preventing food poisoning, reducing number of complaints, complying with local legislation, complying with international legislation, generating customer confidence, reducing industry costs, creating discipline, assuring staff training, improving product quality, enhancing reputation and opening product to external markets; size, location, familiarity, attitude and relevant bodies chosen. The barriers and the

benefits of implementing GMPs and HACCP are the dependent variables while the rest are the independent ones.

B. Study Population and Sample

The study population comprised of all the licensed food industries from all regions of Lebanon: North, South, Beirut, Mount Lebanon and Bekaa. The food industries should have been registered in the Chamber of Commerce, Industry and Agriculture of each of the designated regions or enlisted in the database of the Ministry of Industry.

The industries irrelevant to our study such as kitchen equipment manufacturers and wholesale foodstuff were excluded. Moreover, the industries belonging to the Beirut region were excluded from the study because they were not food production industries but equipment manufacturers, roasters and wholesale facilities. Hence, the population of the study was a total of 213 food production industries that fit the criteria of selection to be eligible to participate in the study (Table 1).

Furthermore, industries in each of the four regions, namely the Bekaa, South, North and Mount Lebanon; were randomly selected. As the response rate was very slow and low, the researcher visited all the regions and collected data from those who fit the criteria and agreed to participate, converting the sampling from a random one to convenient sampling. Thus, the sample included 50 food industries distributed among the four previously mentioned regions that agreed to participate in the study, as participation was completely voluntary (Table 1).

C. Research Instrument

The study instrument was a self-administered questionnaire prepared by the researcher and approved for content validity by expert judges. According to that, the questionnaire was divided into seven parts.

The first part was a series of questions that help collect data about the food safety officer or CEO, as well as the industry's profile, demographics and scope. The food safety officer's education and work experience were important data variables for data analysis.

The second part of the questionnaire asked yes or no questions related to the attitude of the food safety officers toward implementing GMPs and HACCP.

As for the third part, its objective was to test the knowledge of the food safety officer. A table that listed specific entities regarding GMPs and HACCP was included. The food safety officer was requested to identify which entities belong to GMP and which of those belong to HACCP guidelines and principles.

The fourth part of the questionnaire was a list of possible benefits that the food safety officers chose **three** from, and then ranked them in order of importance. These benefits listed include preventing food poisoning, generating customer confidence, assuring staff training, enhancing reputation and other benefits.

The fifth part was a second list that named certain food safety practices adopted by food industries. The food safety officer answered yes or no on whether these practices are implemented or not in the work place.

The sixth part was another list, but this time of barriers that refrain the food industries from applying GMPs and HACCP. Again, the food safety officers will chose **three** from the list; then ranked them according to importance.

Part seven was a series of questions that helped us figure out the incentives needed to adopt GMPs and HACCP in food industries. The questions were about extending markets, supporting HACCP certification and choosing relevant bodies to aid in attaining HACCP certification.

The questionnaire was mainly based on the two articles “*Difficulties and Barriers for the Implementing of HACCP and Food Safety Systems in Food Businesses in Turkey Questionnaire*” (Bas et al, 2007) and “*Factors Influencing Workers to Follow Food Safety Management Systems in Meat Plants in Ontario, Canada*” (Ball et al, 2009)..

The questionnaire was sent with an attached consent form explaining the purpose of the study. It included the human rights compliance information, informing the participating industry of the confidential nature of the information, the risks and benefits of participating; and provided the informed consent required by the Institutional Review Board (IRB)

D. Procedure

The questionnaire was translated from English to Arabic and then back translated by professionals.

For the purpose of human subject protection, an approval from the Institutional Review Board was sought.

By contacting the Ministry of Industry and the Chambers of Commerce, Industry and Agriculture of the Bekaa, South, Beirut and Mount Lebanon, and North regions, a complete list of the active and licensed food industries was collected as the study population. The Chambers of Bekaa, Beirut and Mount Lebanon and South emailed the lists after an official request was sent. Chamber of Commerce, Industry and Agriculture of the North did not have records or lists of its industries. So, the Ministry of Industry was contacted to send the complete list of food industries of that region.

Once all the lists were collected, they were revised. Some of the industries on the list were not production industries. However, they were wholesale or equipment manufacturing industries. These industries were eliminated from the list. At the end of the revision, the Beirut list was excluded from the list, Mount Lebanon had 5 industries, Bekaa had 109 industries, South had 86 industries and the North had 13 industries. This calculated the study population to be a total of 213 industries.

Upon receiving the lists from the Chamber of Commerce, Industry and Agriculture, 50 industries were randomly selected and an invitation letter was sent through email to the human resources department of each of the industries, along with the copy of the IRB approval explaining the purpose of the study and objective; and asking for their consent to participate.

Eventhough we contacted some of the industries, directly and in person, to explain the project and ask them to cooperate; only 17 questionnaires were completed and returned by email. This necessitated personal visits from the researcher to each of the four regions,

asking for the approval to participate. Upon their approval, the researcher met with food safety officer or directors of the food industries. Questionnaires were filled during the meeting. After more than two weeks of visiting all four regions, despite the security issues that Lebanon was going through in the South and North, only 33 additional industries cooperated. The rest chose not to be included in the study.

All filled questionnaires were stored in a safe place.

E. Data Analysis

The SPSS 20.0 program was used for analyzing the data collected from the questionnaires.

Frequency tables were prepared to compare the distribution of the food industries in the sample group with the total number of Lebanese Food Industries in the study population. Another table constituted the distribution of the food industries by selected characteristics; namely, size of the industry, type, markets of the products, education of the food safety officer, and education of the directors.

Descriptive statistics were performed to categorize the food industries based on specific barriers (lack of knowledge, resistance to change, cost issues, infrastructure and facilities, lack of training, etc...). Food industries were also described based on the different benefits that they have selected for implementing GMPs and HACCP. Moreover, the certifying bodies, selected by the food industries, were also represented and compared according to size, location, and type of industry.

One sample proportion test (Z test) was done to test the hypothesis of the research study,

Comparisons of distribution of barriers were made based on the size of industries, locations, and type of product using a chi square test. Comparisons of distribution of benefits were also made based on the size of the industries, locations and type of product using a chi square test. These comparisons pointed out the independent variables are related to the barriers and the benefits of implementing GMPs and HACCP in the Lebanese food industries.

In addition to these tables, familiarity of each HACCP and GMPs, representing the knowledge attribute, were cross-tabulated with the size of the industry and with the principles of HACCP, along with the entities of GMPs. These tables targeted the independent variables; namely location and size; that influence the dependent variables, namely familiarity and knowledge.

Familiarity was also cross-tabbed with the education level of the food safety officer or director and the years of experience that the food safety officers or directors have. The education and the years of experience were tested whether they affect the knowledge the food officers or directors have about GMPs and HACCP.

An additional score of knowledge was computed by looking at the correct answers of question 18 in the questionnaire. Question 18 is a table that asked the food safety officers and directors to indicate the corresponding food safety system (GMP or HACCP) of each of the items in the list provided. The score is from 0 to 10 depending on how many of the

10 questions have they answered correctly. The total score of knowledge is the summation of the GMP knowledge score with the HACCP knowledge score.

Another independent variable, namely relevant bodies; were cross-tabbed with the size of the industry, location of the industry, and type of the industry to learn about the choices of the supportive bodies the different industries selected, and whether the different factors affect these choices.

Another comparison was made between the difficulty of implementing HACCP and the cost of acquiring HACCP. This comparison was to check whether difficulty and cost are in sync according to the Lebanese food industries that are interested in acquiring or implementing HACCP.

A frequency distribution of individual items of each knowledge and attitude data was presented. Two scores on knowledge and attitudes were computed by adding up the items comprising these two measures. Their mean sums and standard deviation were calculated.

It is also important to mention that the categories of answers were collapsed so that binomial analysis becomes possible. For example, when ranking the level of importance of benefits and barriers, three categories were given as choices, namely greatest importance, some importance and least importance. These categories were recoded as selected versus not selected, where the “selected” category included the choices of great importance and some importance and the “not selected” category included the least important choice and the other benefits or barriers that were not selected. Another collapsing of categories was made in the knowledge question when asked about the familiarity concerning GMPs and

HACCP. The choices were of four categories, namely familiar to a great extent, some extent, and little extent or not familiar at all. The categories have been altered to represent familiar versus not familiar by merging great extent and some extent in one category and little to no extent in another category.

The results of the tables were ranked in descending order to serve the purpose of distinguishing the answers that the food safety officers and directors have chosen the most.

With the Chi-square test and frequency distribution, relationships between the barriers and size attribute will be affirmed or denied. The same tests were used to check whether the benefits selected and the preferred supportive bodies have an existing relationship with the independent variables that were mentioned above. Testing for statistical significance was performed when comparing barriers, benefits and certifying bodies according to size.

CHAPTER FOUR

RESULTS

A. Size of the Industry

The WHO (1999) defined in its report “Strategies for Implementing HACCP in SLDBs” the factors characterizing small businesses as follows: “...because of their size, lack of technical expertise, economic resources, or the nature of their work, encounter difficulties in implementing HACCP in their food business” (WHO, 1999). Shenazi (2013) also provided classifications of small businesses. She stated that small business or industries are classified by having a small number of employees, acquiring low profit levels, serving local markets and having one owner or a small group of people as owners (Shenazi, 2013). The two definitions match the characteristics of small to medium sized industries in the sample group.

Therefore, the size of the industries was divided into two: small to medium and large industries. The small to medium industries are those that have less than 50 employees while the large industries are those that have 50 employees and above. The sample size was 50 (27 small to medium size industries and 23 large industries) as presented in Table 1).

Table 1
Frequency Distribution of Industries by Selected Characters

Character	N=50	Percentage of Total
Type of Industry		
Biscuits, chocolates, sweets, chips	19	38%
Beverages and Spirit	11	22%
Dairy products	10	20%
Salt, herbs and spices	5	10%
Meat and poultry	2	4%
Bread	2	4%
Processed foods and cans	1	2%
Size of the Industry		
Small to medium	27	54%
Large	23	46%

B. Geographical Distribution of Industries

The sizes of the food industries vary from one region to another. For example, out of the 27 small industries, 4 (100%) are in the North, 4 (29%) are in the South, 19 (63%) are in the Bekaa and none in Mount Lebanon. On the other hand, out of the 23 large industries, none are in the North, 10 (71%) are in the South, 11 (36%) in the Bekaa and 2 (100%) in Mount Lebanon (Table 2).

Table 2

Frequency Distribution of Study Population and Sample Group by Region

Region	Study Population	Sample Group
Bekaa	109 (51%)	30 (60%)
South	86 (40%)	14 (28%)
North	13 (6%)	4 (8%)
Mount Lebanon	5 (3%)	2 (4%)
Total	213 (100%)	50 (100%)

C. Type of Industry

The types of food industries that have been encountered in this study are seven. They are 10 (20%) dairy production industries, 11 (22%) beverages and spirits industries, 19 (38%) sweets and chips industries, 1 (2%) processed foods and cans industry, 2 (4%) meat and poultry industries, 5 (10%) herbs and spices industries and finally 2 (4%) bread production industries (Table 1). Moreover, 5 (10%) industries of the sample group are HACCP certified, three of them are dairy production industries and 2 of them are beverage industries. In addition, 2 (4%) industries of the sample group were ISO certified; both of them were dairy production industries.

D. Familiarity of Food Safety Officers/ Managers about Food Safety Management Systems

Twenty three (85%) out of 27 small to medium sized industries are familiar with GMPs and HACCP to a great or some extent, while only 4 (15%) are not familiar (Table 3). As for the large industries, 22 (95%) out of 23 industries are familiar with GMPs and HACCP to a great or some extent, while only one industry is not familiar with food safety management systems (Table 3).

Table 3
Frequency Distribution of knowledge about GMPs and HACCP by size of industry

Familiarity	Size	
	Small to Medium (N=27)	Large (N=23)
Familiarity of GMP		
Great to Some Extent	23	22
Little to No Extent	4	1
Familiarity of HACCP		
Great to Some Extent	23	22
Little to No Extent	4	1

As for the familiarity of the industries about ISO 22000, 22 (81%) out of the 27 small to medium sized industries are familiar to a great or some extent while 5 (19%) are not familiar with ISO 22000. Out of the 23 large industries, 22 are familiar to a great or some extent about ISO while one industry is not familiar at all.

The familiarity with food safety management systems was found among food safety officers in both small to medium and large industries; however, in large industries the percentage was higher. There was a significant difference between size and knowledge ($p=0.015$)

GMPs, HACCP and ISO familiarity varied across the regions. Concerning GMPs and HACCP, all 4 industries in the North are familiar to a great or some extent, 12 (85%) industries in the South are familiar with both food safety systems, 27 (90%) industries in the Bekaa are familiar and both industries in Mount Lebanon are familiar with GMPs and HACCP.

As for ISO familiarity, in the North all 4 were familiar to a great or some extent with ISO. In the South, 12 (85%) of the 14 were familiar to a great or some extent. On the other hand, in the Bekaa, 26 (86%) of the 30 industries were familiar with ISO while 4 (14%) knew nothing about ISO. As for Mount Lebanon, both industries were familiar with ISO 22000.

In addition to that, all industries seem to apply food safety practices, even if they don't implement a specific food safety management system. They implement basic hygienic practices, try to avoid cross contamination and carry out routine checks. However, of the food safety practices, only one item from the list was never selected: "have regular seminars and lectures".

E. Barriers to the Implementation of Food Management Systems

The barriers selected by the sample group were compared to the size and type of the industries, and geographical distribution.

Size is an independent variable that was cross-tabbed with the barriers of implementing GMPs and HACCP. Out of the 27 small to medium sized industries, 17(62%) chose cost as a barrier, 8(29%) chose poor infrastructure and facilities, and 7(26%) chose lack of prerequisite programs. Specifically, education and staff training was also a barrier selected by 6(22%) small to medium industries; government infrastructure and commitment was selected by an additional 4(15%) industries. As for the excessive paperwork and documentation, it was chosen by 4(15%) industries while technical support and awareness of the staff were reported by 3(11%) industries each. The barrier of “resistance to change” was only chosen by 2(7%) industries (Table 4).

As for the large industries, 18(78%) of this category chose cost as a barrier, 13(56%) chose infrastructure and facilities, 6(26%) chose government infrastructure and commitment and 5(22%) chose lack of prerequisite programs. 2 (8%) large industries chose awareness and expertise of the staff as a barrier, while 1(4%) industry chose education and training of the staff and none of the large industries selected excessive paperwork and documentation or technical support.

Statistically, size of the industries and the barriers selected were not significantly different. This is due to the small sample size where statistical comparisons don't act as a robust analytical approach.

Table 4
Percent reporting the specific barriers by size of industry

Barriers	Size	
	Small to Medium (N=27)	Large (N=23)
Cost	17 (62%)	18 (78%)
Infrastructure and Facilities	8 (29%)	13 (56%)
Lack of Prerequisite Programs	7 (26%)	5 (22%)
Government Infrastructure and Commitment	4 (15%)	6 (26%)
Education and Training of Staff	6 (22%)	1 (4%)
Awareness and Expertise of Staff	3 (11%)	2 (8%)
Excessive Paperwork and Documentation	4 (15%)	0 (0%)
Technical Support	3 (11%)	1 (4%)
Resistance to Change	2 (7%)	0 (0%)

Hence, the barriers of greatest frequency among small to medium sized industries are cost (62%), infrastructure and facilities (29%) and lack of prerequisite programs (26%). As for the large industries, the barriers mostly selected are cost (78%), infrastructures and facilities (56%) and government infrastructure and commitment (26%). The least three barriers considered by both categories of industries are the excessive paperwork and documentation, technical support and resistance to change.

The choices of barriers that each location or region has selected in our study varies from the other. Of the 4 industries in the North, 3 (75%) have selected cost as a barrier for implementing GMPs and HACCP. Other barriers such as infrastructure and facilities, lack of prerequisite programs, education and training of staff, excessive paperwork and documentation and resistance to change have all been selected by one industry each. Government infrastructure, awareness and expertise of staff and technical support have not been selected at all.

As for the South, of the 14 industries, 10 (71%) have chosen cost as a barrier, 6 (43%) chose infrastructure and facilities and 5 (35%) chose lack of prerequisite programs (Table 5). Another barrier, such as government infrastructure and commitment, was selected by 4 (29%) different industries. Two industries selected education and training of staff and one industry selected awareness and expertise of staff. Other barriers, such as excessive paperwork and documentation, technical support and resistance to change, have not been selected by any of the industries in the South.

In the Bekaa region, 21 (70%) out of 30 industries chose cost as a barrier, 12 (40%) industries chose infrastructure and facilities, while 6 (20%) chose government infrastructure and commitment (Table5). Lack of prerequisite programs was chosen by 5 (16%) industries in the Bekaa and 4 (13%) industries picked education and training of staff, awareness and expertise of staff, and technical support. Three other industries picked excessive paperwork and documentation as a barrier, while one industry in the Bekaa chose resistance to change (Table5).

Finally in Mount Lebanon, 2 industries chose infrastructure and facilities as a barrier, while one industry selected cost and another selected lack of prerequisite programs (Table 5). The other barriers were not selected in Mount Lebanon.

Table 5
Frequency Distribution of Barriers by location

Barriers	Location			
	North	South	Bekaa	Mount Lebanon
Cost	3	10	21	1
Infrastructure and Facilities	1	6	12	2
Lack of Prerequisite Programs	1	5	5	1
Government Infrastructure and Commitment	0	4	6	0

***Barriers that were selected by less than 10 industries were not included in the table.**

The cost and the food plants infrastructures and facilities were considered as main barriers by the majority of food industries independently of the type of produced goods. Regarding the dairy production industries, 8 (80%), 3(30%), 3(30%), and 3(30%) industries chose cost, infrastructures and facilities, prerequisite programs, and government infrastructure and commitment, respectively, as barriers to implementing GMPs and HACCP (Figure 1). In addition, education and training of staff and the awareness and

expertise of the staff were picked by 1 dairy production industry (Figure 1). Moreover, technical support was also picked by one dairy production industry. Other barriers such as excessive paperwork and documentation and resistance to change were not considered as a barrier for the implementation of food safety management systems by the dairy production industries.

As for the beverages and spirits industries, 8 (72%) industries chose cost as a barrier, 7 (63%) industries chose infrastructure and facilities as a barrier, 2 industries (18%) chose government infrastructure and commitment and another 2 (18%) industries selected excessive paperwork and technical support as barriers (Figure 1). Moreover, awareness and expertise of staff was a barrier identified by one of the beverages and spirits industries. On the other hand, lack of prerequisite programs, education and training of staff, and resistance to change are barriers that were not selected by the industries that produce beverages and spirit (Figure 1).

Regarding the industries of sweets, chocolates, chips and biscuits, 14 (74%) of these industries have picked cost as a barrier, 7 (37%) industries have picked infrastructure and facilities, and another group of 7 (37%) industries have picked lack of prerequisite programs (Figure 1). In addition, 4 (21%) industries have chosen government infrastructure and commitment as a barrier. As for the education and training of staff, 2 (10%) of the sweets and chips industries have picked it as a barrier (Figure 1). The awareness and expertise of staff and the excessive paperwork and documentation have been chosen by one industry each as barriers. As for technical support and resistance to change, they were not selected by any of the industries in this category (Figure 1).

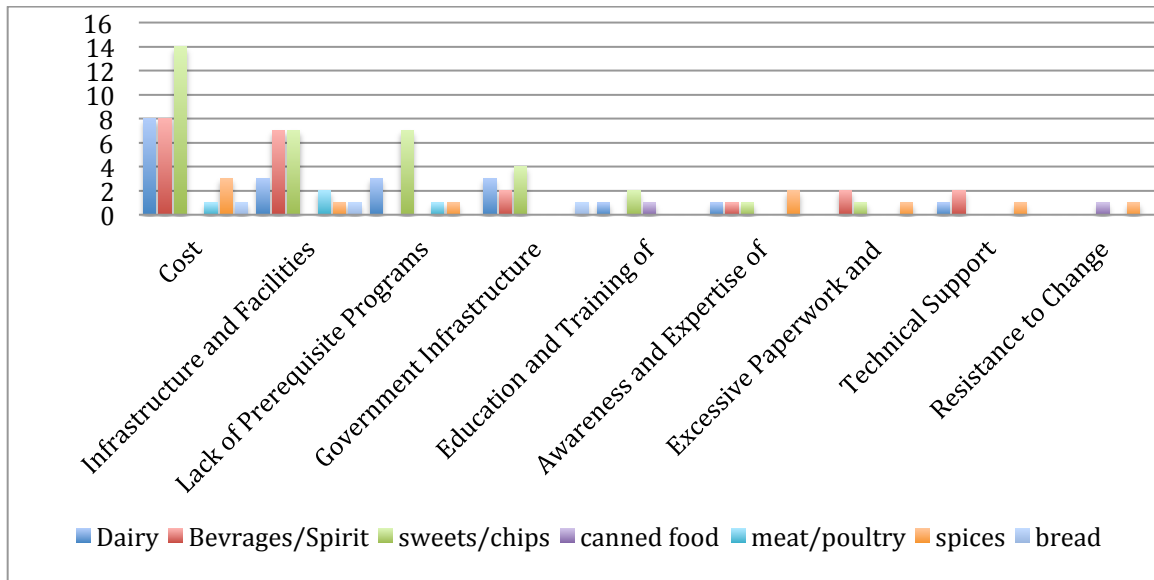
The next type of industries is the canned food industries. The barriers chosen by the 2 industries were education and training of staff and resistance to change. All the other barriers were not selected (Figure 1).

As for the four poultry and meat industries, the barriers chosen were cost, infrastructure and facilities and lack of prerequisite programs. Infrastructure and facilities was selected by two of the four industries and the other two barriers were selected by one industry each (Figure 1).

The next type of industries is the spices, herbs and salt industries. Cost was selected by 3 (60%) industries and awareness and expertise of staff was selected by 2 (20%) industries (Figure 1). As for the barriers infrastructure and facilities, lack of prerequisite programs, excessive paperwork and documentation, technical support and resistance to change, they have all been selected by one industry of each.

As for the last type of industries, the 4 bread production industries, they have chosen cost, infrastructure and facilities and government infrastructure and commitment as barriers that they might encounter when implementing HACCP. All other barriers were not selected. (Figure 1)

Figure 1
Frequency Distribution of Barriers by type of industry



F. Benefits to the Implementation of Food Safety Management Systems

As was done with the list of barriers selected, the benefits chosen by the sample group were compared with the size and type of the industries, and geographical distribution of the industries.

The benefits reported with the highest frequencies among the small to medium sized industries are clustered between 3 choices. Eleven (41%) of the small industries chose the improvement of product quality, 10 (37%) industries chose opening the product to external markets and another 9 (34%) chose generating customer confidence (Table 6). Seven (26%) small to medium sized industries chose the prevention of food poisoning, while 6 (23%) chose enhancing reputation and 5 (19%) other chose creating discipline (Table 6). Three (12%) small to medium sized industries selected reducing industry costs, while 2

(8%) different industries selected reducing number of complaints and compliance with international legislation (Table 6). Local legislations and staff training were not recognized by small to medium industries as important benefits.

As for the large industries, the clusters vary. For instance, 19 (83%) of the large industries chose the prevention of food poisoning as a benefit of great importance. Eight (23%) chose improving product quality and 7 (31%) industries chose generating customer confidence (Table 6). The other benefits selected were as follows: 5 (22%) large industries selected acting as a legal defense, 4 (18%) industries selected opening the product to external markets and 2 (9%) large industries selected reducing number of complaints (Table 6). As for the rest, only one industry chose reducing industrial costs and none of the large industries indicated enhancing reputation, creating discipline, assuring staff training or complying with local legislation.

The different sizes of the industries give way to different concerns, which guides the food industries in different direction on why they should implement or integrate GMPs and HACCP in their system (WHO, 1999).

Table 6
Percent reporting the specific benefits by size of industry

Benefits	Size	
	Small to Medium (N=27)	Large (N=23)
Prevents Food Poisoning	7 (26%)	19 (82%)
Improves Product Quality	11 (40%)	8 (35%)
Generates Customer Confidence	9 (33%)	7 (30%)
Opening Product to External Markets	10 (37%)	4 (17%)
Enhances Reputation	6 (22%)	0 (0%)
Creates Discipline	5 (19%)	0 (0%)
Acts as Legal Defense	0 (0%)	5 (22%)
Reduces Number of Complaints	2 (7%)	2 (9%)
Complies with International	2 (7%)	0 (0%)

 Legislation

Reduces Industry Costs	3 (11%)	1 (4%)
Assures Staff Training	0 (0%)	0 (0%)
Complies with Local Legislation	0 (0%)	0 (0%)

Statistically, prevention of food poisoning, acting as a legal defense against complaints, creating discipline, and enhancing reputation, were all benefits that were significantly different by size ($p < 0.05$).

Taking the location as a variable, the clusters of responses on the benefits of implementing GMPs and HACCP sheds light on different aspects and factors that need to be taken in consideration by food industries and policy makers.

In the North region, 2 (50%) industries chose the prevention of food poisoning, opening product to external markets and reducing number of complaints (Table 7). One industry chose the following benefits: improving product quality, generating customer confidence, and creating discipline (Table 7). The other benefits; namely, enhancing reputation, acting as a legal defense, complying with international legislation, reducing industry costs and assuring staff training and complying with local legislation, were not selected by any industry (Table 7).

As for the South, 9 (65%) of the 14 industries chose prevention of food poisoning as the most importance benefit from applying GMPs and HACCP (Table 7). Seven (50%) industries in the South saw that generating customer confidence is a very important benefit, while 5 (36%) different industries chose improving product quality as another benefit (Table 7). Opening the product to external markets was selected by 4 (29%) different industries, while the benefit of acting as a legal defense has been chosen by 2 (15%) different industries in the South (Table 7). One industry selected creating discipline as a benefit while all the other benefits were not selected at all.

In Bekaa, 13 (44%) out of the 30 industries picked prevention of food poisoning as a benefit (Table 7). Another 7 (24%) industries saw that improving product quality is a very important benefit from applying HACCP (Table 7). A different group of 7 (24%) industries in the Bekaa chose opening the product to external markets as a benefit of second importance (Table 7).

In Mount Lebanon, both of the industries chose preventing food poisoning as a primary benefit from integrating GMPS and HACCP as part of their food safety system (Table 7).

The different regions and locations have showed a difference in the choices made by the industries concerning the benefits they see as a result in implementing GMPs and HACCP.

Table 7
Percent reporting benefits by location of industry

Benefits*	Location			
	North	South	Bekaa	Mount Lebanon
Prevents Food Poisoning	2	9	13	2
Improves Product Quality	1	5	12	1
Generates Customer Confidence	1	7	7	1
Opening Product to External Markets	2	4	8	0

*Benefits that were selected by less than 10 industries were not included in the table.

The benefits of implementing GMPs and HACCP were also cross-tabbed with the types of industries (Figure 2). The results are as follows:

Prevention of food poisoning was only selected by 5 (50%) of dairy production industries, although dairy products are considered potentially hazardous foods and the main objective of implementing the HACCP system in such industries is to reduce/prevent food hazards. Five (46%) beverages and spirits industries, 11 (58%) sweets and chips industries,

2 (100%) meat and poultry industries, 2 (40%) spices and herbs industries and 1(100%) bread production industry. Prevention of food poisoning is not a benefit selected by the canned food industry (Figure 2).

Improving product quality was chosen by 3 (30%) dairy production industries, 5 (46%) beverages and spirits industries, 10 (53%) sweets and chips industries, and 1 (20%) spices and herbs industry. Improving product quality was not selected by the canned food industry, meat and poultry production or bread production industries (Figure 2).

As for generating customer confidence, the benefit was selected by 1 dairy production industry (10%), 4 (37%) beverages and spirit industries, 7 (37%) sweets and chips industries, 1 (50%) meat and poultry industry, 1 (20%) herb and spices industry and finally 2 (100%) bread production industries. This benefit was not selected by the canned food industries. (Figure 2)

Opening the product to external markets is a benefit selected by 5 (100%) dairy production industries, 3 (28%) beverages and spirits industries, 5 (27%) sweets and chips industries, and 1 (100%) canned food industry. It was not chosen by the meat and poultry industries, spices and herbs or bread production industries. (Figure 2)

The next benefit, enhancing reputation, was picked by 2 (20%) dairy production industries, 1 (6%) sweets and chips industry, 2 (40%) spices industries and 1 (50%) bread production industry. Beverages and spirit, canned food industries, or meat and poultry production industries did not pick the benefit, enhancing reputation. (Figure 2)

As for creating discipline, it was chosen once by each of the dairy industries, sweets and chips industries, and canned food industry. It was also chosen by 2 of the spices industries. However, beverages and spirit, meat and poultry industries and bread production industries did not choose this benefit (Figure 2).

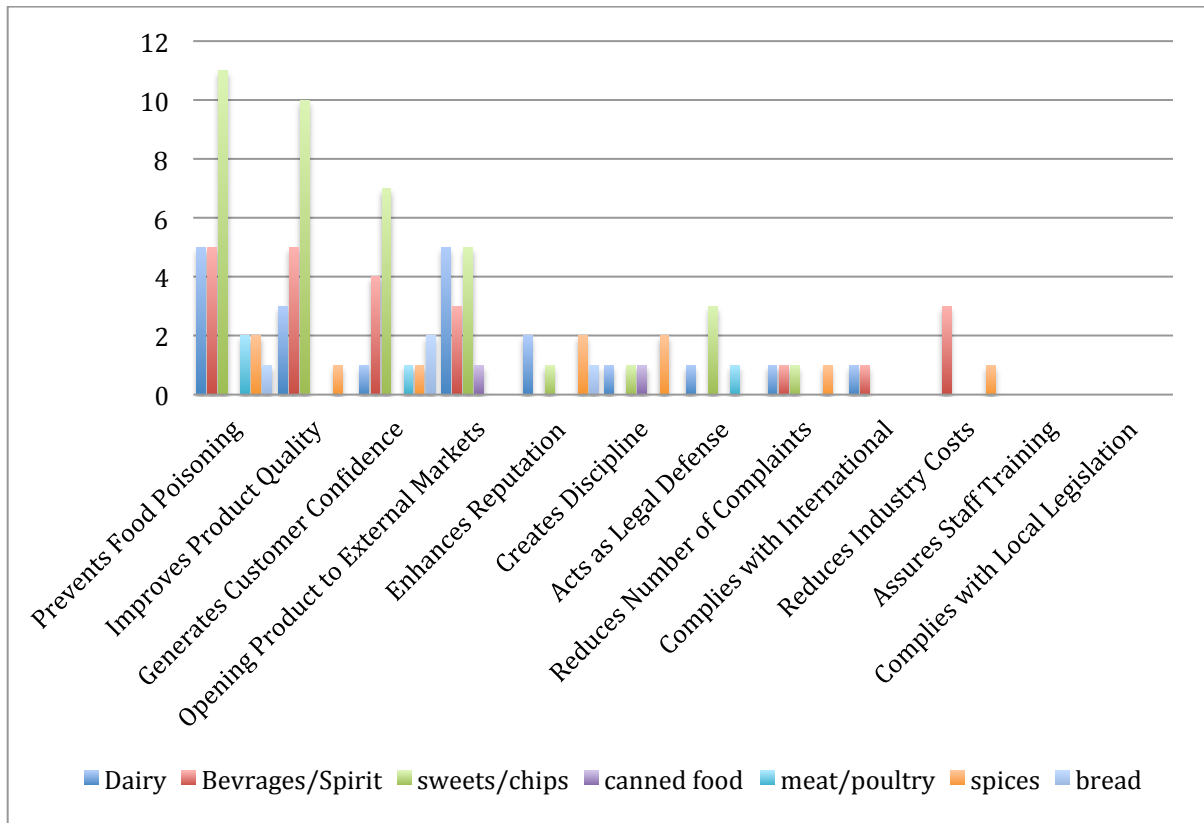
Acting as a legal defense is a benefit chosen by 1 dairy production industry and 1 meat and poultry industry. It was also chosen by 3 sweets and chips industries. However, the beverages and spirit industries, canned food industries, spices and herbs and bread production industries did not choose it (Figure 2).

Another benefit, reducing the number of complaints, was picked by 1 industry of each the dairy production, beverages and spirit, sweets and chips, and spices and herbs. It was not selected by canned food industries, meat and poultry or bread industries (Figure 2).

The benefit of complying with international legislation was indicated by 1 dairy production industry and 1 beverages and spirit industry. It was not selected by any of the other food industries. These results could be related to the lack of knowledge and awareness about the regional and international legislations. (Figure 2)

As for reducing industry costs, 3 industries of beverages and spirit and 1 industry of herbs and spices chose it. However, it was not selected by other industries (Figure 2). However, the last two benefits, assuring staff training and complying with local legislation, were not selected by any of the industries. In other words, the two mentioned above are not considered as benefits of implementing GMPs and HACCP (Figure 2).

Figure 2
Frequency Distribution of Benefits by type of industry



G. Preferred Supportive Body to Implement Food Safety Management systems

Of the 27 small to medium sized industries, 13 (49%) opted for an independent food authority as their choice for support and guidance (Figure 3). 11 (41%) small to medium sized industries chose the private sector and NGOs as certifying food control bodies, while 9 (34%) other industries picked the Ministry of Agriculture as their first choice. On the other hand, 6 (23%) small sized industries saw that the Ministry of Industry must take charge of food control in Lebanon. As for the academic institution and the Ministry of

Economy and Trade, just 2 (8%) small industries chose each of these bodies for support and guidance. Finally, the Ministry of Environment was only selected by one industry to be the body in charge of implementing GMPs and HACCP and helping the industries acquiring certification (Figure 3)

As for the 23 large industries, 17 (74%) of them have also preferred an independent food authority as the body to be in charge, while 13 (57%) other industries preferred the Ministry of Industry. In addition, 7 (31%) large industries have picked the academic sector as their supportive body for acquiring the HACCP certification. The Ministry of Agriculture was picked by 5 (22%) large industries, while the Ministry of Economy and Trade was selected by 4 (18%) large industries. However, the private sector was chosen by 3 (13%) large industries and the Ministry of Environment was selected by only one large industry (Figure 3). By looking at the results, an independent food authority is the primary choice of both, small to medium and large industries.

Statistically, the Ministry of Industry, the private sector and the academic sector were significantly different by size ($p < 0.05$).

Looking into the list of relevant bodies that can help control and support the food industries in Lebanon, it is evident that all of them can play a role in integrating GMPs and HACCP in the Lebanese food industries. Still, the locations of the industries in Lebanon may debate the preferences of relevant bodies to help out with the integration of HACCP in their food safety systems.

Two out of four (50%) industries in the North (n=4) preferred the Ministry of Industry and one selected the Ministry of Agriculture, the private sector and the independent food authority. None of the industries in the North selected the academic sector, private sector, the Ministry of Environment or the Ministry of Economy and Trade. (Figure 4)

In the South (n=14), 8 (58%) industries chose the independent food authority as the preferred body to help and support them through the process of HACCP implementation and certification. As for the Ministry of Industry, 6 (43%) industries chose it as a preference to other bodies, while another group of 4 (29%) industries selected the private sector. Three (22%) industries in the South chose Ministry of Economy and Trade and 2 (15%) others chose the academic sector. As for the Ministry of Environment and the Ministry of Agriculture, one industry selected each of these bodies (Figure 4)

As for the Bekaa region (n=30), 19 (64%) industries selected an independent food authority as their choice for a certifying body. 11 (37%) industries chose the Ministry of Agriculture, 10 (34%) chose the Ministry of Industry, and 9 (30%) chose the private sector as the supportive relevant body. As for the academic sector, 6 (20%) different industries opted for it as a supportive relevant body, while 3 (10%) chose the Ministry of Economy and Trade and one chose the Ministry of Environment (Figure 4).

In Mount Lebanon (n= 2), two industries selected the independent food authority as their choice of a supportive relevant body. The academic sector, Ministry of Agriculture and the Ministry of Industry were each. Selected by one food control body. The other

bodies; namely Ministry of Environment, Ministry of Economy and Trade, and the private sector, were not selected at all (Figure 4)

Figure 3
 Frequency Distribution of Preferred Selected Bodies by size

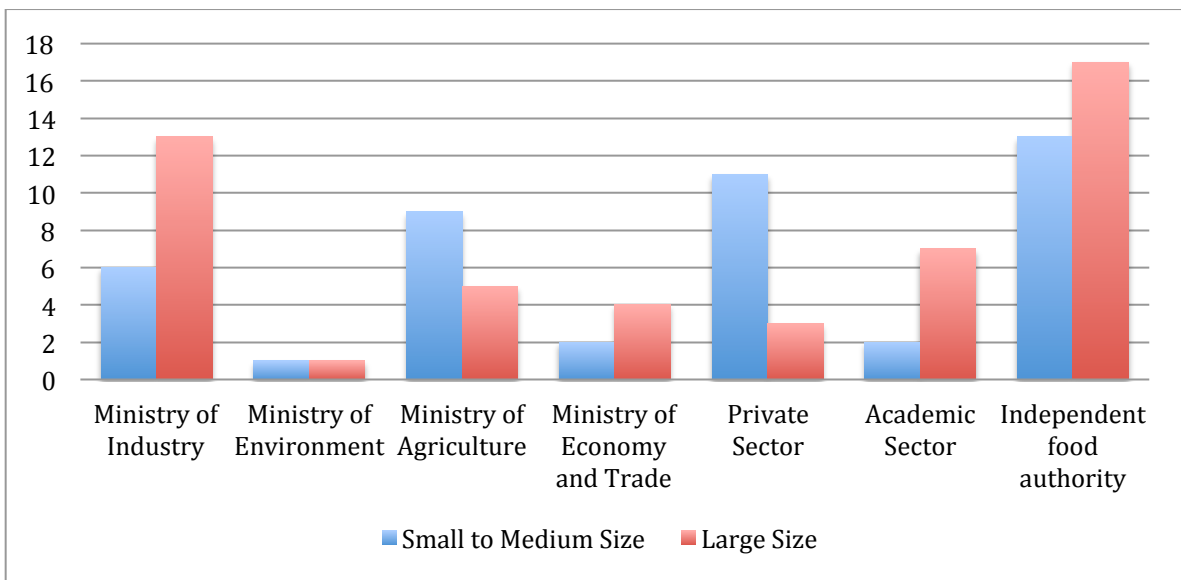
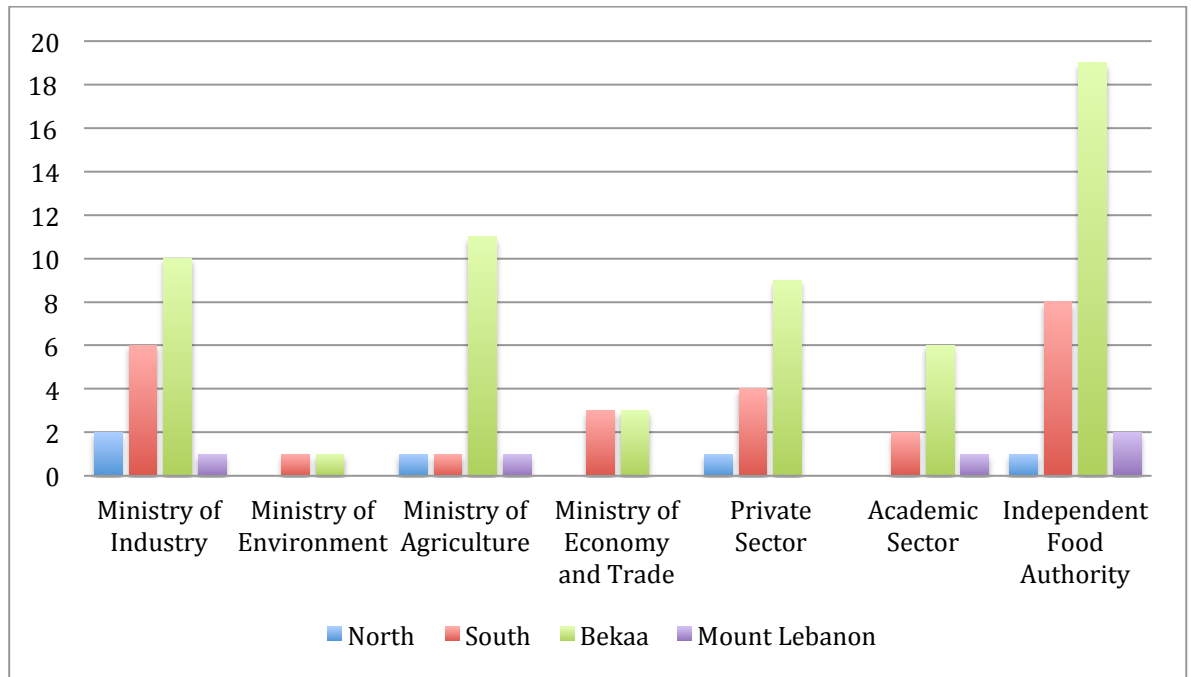


Figure 4
Frequency Distribution of Preferred Selected Bodies by location



Moreover, the types of industries in the study were also compared with the supportive relevant bodies that have been listed in the questionnaire. Six (60%) of the dairy production industries chose an independent food authority to be in charge of the HACCP implementation, while 5 (50%) other industries selected the Ministry of Industry. Moreover, 3 (30%) of the dairy industries chose the academic sector as their choice of a certifying body, while 2 (20%) industries selected each of the private sector and the Ministry of Economy and Trade as a relevant certifying body. The Ministry of Environment and the Ministry of Agriculture were considered as a supportive relevant body by only one dairy industry. (Figure 5)

As for the beverages and spirits industries, 8 (73%) selected the independent food authority and 7 (64%) of them chose the Ministry of Agriculture as supportive relevant bodies. In addition, 4 (37%) beverage and spirit industries chose the private sector and the 3 (28%) other industries chose the Ministry of Industry as their preferred supportive bodies. As for the academic sector, 2 (19%) of these industries picked it as the supportive relevant body. The beverages and spirit industries did not select the other bodies enlisted. (Figure 5)

Next, 10 (53%) industries that belong to the sweets, chips, biscuits and chocolates production have chosen an independent food authority as their choice. Another 8 (43%) industries picked the Ministry of Industry, while a group of 5 (27%) industries picked the private sector as a supportive body. Moreover, 4 (21%) industries chose the Ministry of Economy and Trade, 3 (16%) industries chose the Ministry of Agriculture, 1 industry chose the Ministry of Environment and another single industry chose the academic sector as a supportive body (Figure 5).

As for the canned food industries, the single industry in the study group has chosen an independent food authority as the certifying relevant body. The other bodies were not selected (Figure 5).

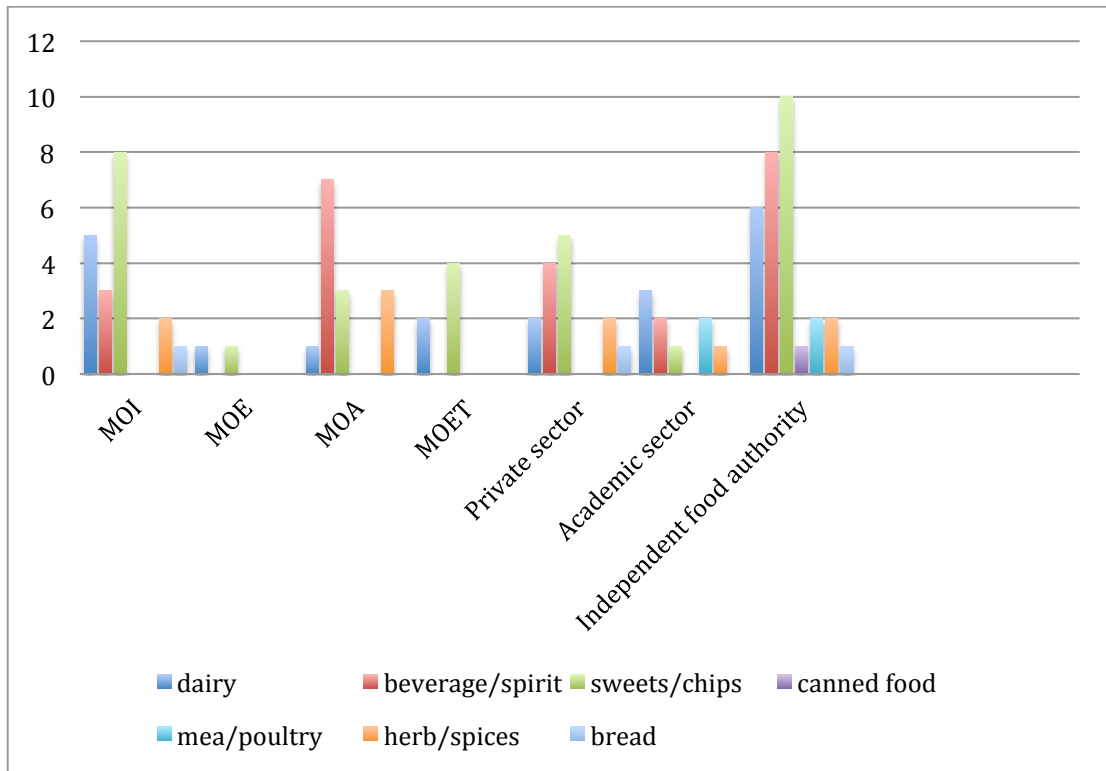
Two of the meat and poultry industries chose the independent food authority and academic sector as their supportive relevant bodies. The rest were not selected (Figure 5).

On the other hand, three (60%) of the herb and spices industries chose the Ministry of Agriculture. Two (40%) other industries of this type of production chose each of the

Ministry of Industry, the private sector and an independent food authority. In addition, the academic sector was selected by one of the herbs and spices industries (Figure 5).

As for the bread production industries, the Ministry of Industry, the private sector and an independent food authority were each selected once to act as food control bodies. The bread industries did not choose the other bodies enlisted in the questionnaire (Figure 5).

Figure 5
Frequency of Distribution of Preferred Selected Bodies by type of industry



Moreover, the hypothesis was tested using a Z test. The null hypothesis concerning cost as a barrier was rejected with $z = 2.38$, greater than 1.645. On the other hand, the null hypotheses of resistance to change and lack of knowledge were retained with z less than 1.645.

As a result, the main barriers selected are cost, infrastructure and facilities, and lack of prerequisite programs. On the other hand, the main benefits selected are preventing food poisoning, improving product quality and generating customer confidence. Assigning an independent food authority is the mostly selected certifying body.

CHAPTER FIVE

DISCUSSION

To begin with, collecting the sample of 50 industries was not an easy task. After the many rejections that occurred on the phone, we contacted the industries directly. In addition, personal visits were done, across all regions. The security conditions in Lebanon at that time were not at their best with constant attacks happening in the North and South. For over 2 weeks, more rejections took place; over 20 industries chose not to be included in the study. This shows that despite all efforts, a big group of industries wanted their conditions and management systems to remain private and not shared to the public. To refuse to participate in an anonymous, academic study is evidence enough that the conditions found there are far worse than the conditions found in the sample group collected (50 industries).

The small sample size is considered the limitation of this study because significance between independent and dependent variables will be difficult to be represented with statistical tests. A larger sample is normally required. That's why statistical significance was performed with only one independent variable (size) under the conditions of a 2 by 2 cross tabulation.

As for the strengths of the study, it is an original study that has not been performed before in Lebanon, which identified the barriers and benefits to implementing GMPs and HACCP. Global barriers have been compared with those found in Lebanon and short term and long term solutions were recommended. Moreover, preferred certifying bodies were

identified by the participants and the food safety conditions in Lebanon's industries have been revealed. Case studies and global examples have all been an added value to the project that put Lebanon in context with the rest of the world.

A. Barriers to the Implementation of Food Safety Management Systems

1. Size of the industries

Industries with a very small number of employees ranging between 3 and 10 are mostly family businesses. In such industries, implementation of food safety is of no major interest, and industrial practices inherited from the ancestors are practiced and adhered to. However, certain external forces namely regulations, food control authorities, and market forces pressure small industries to apply HACCP (WHO, 1999). In Lebanon, such external forces are absent. GMPs, HACCP or ISO are not recognized and their implementation is mostly considered as a major financial burden.

The majority of the small industries have poor infrastructures that do not meet the standards and requirements of HACCP or ISO as presented in table 6. In addition, the lack of prerequisite programs poses as an additional barrier that restricts these industries from implementing or integrating HACCP into their food safety systems (Table 4). WHO (1999) recognizes that the interdependency between HACCP and its prerequisite programs cannot be ignored. The prerequisite programs will definitely facilitate the implementation of HACCP (WHO, 1999). As such, the absence of prerequisite programs, along with the poor infrastructure, will lead to major changes in the industry. To execute these changes, a significant budget is needed. Such small industries do not have the financial capability,

time or foundations for the needed changes. As such, the easier option for them is to produce and manage the industry as they have always been doing, without the integration of GMPs and HACCP. Another barrier that has been selected is the poor governmental involvement (Table 4). This is an important sign that the small to medium sized industries are not finding the support and commitment that they expect from the government. The government's support and authority act as an external force that should direct and guide these small industries (WHO, 1999). Passive governments and lack of commitment will not encourage these small to medium industries to improve, evolve or expand (WHO, 1999).

On the other hand, the other 23 industries are categorized under large industries. Many of these large industries belong to international markets and some produce more than one product. All of these industries are familiar with ISO certification. As for GMPs and HACCP, 22 (96%) of the 23 large industries know about GMPs and HACCP while only one industry of this category knows nothing about them as presented in table 3.

Regarding knowledge, food safety officers in large sized industries know more about GMPs and HACCP than in the small sized industries (Table 3). This can be due to the exposure of large industries to external markets and different product lines. Similarly, in a study done in Turkey, with a sample of 40 industries, 19 were certified by HACCP. Among these 19 industries, more than half were large sized industries (CIHEAM, 2007). As for the 21 remaining industries that do not apply HACCP, 71% of them are small sized industries (CIHEAM, 2007). The reasons for not applying HACCP in the small sized

industries in Turkey were the “inadequacy of food handlers, incompetent knowledge about the subject and the high cost of the system” (CIHEAM, 2007).

Knowledge is considered an internal factor that acts as a barrier, which may impede the implementation of HACCP (WHO, 1999). The barriers mostly selected by the large industries are cost, infrastructure and facilities and government infrastructure and commitment as presented in table 8. Two out of three barriers are the same between small and large size industries; however, the frequency distribution differs. Cost was chosen by 62% of the small industries, while 78% of the large industries picked it. 29% of the small industries chose infrastructure and facilities, while 56% of the large industries picked it (Table 8), This shows that small industries have less knowledge about GMPs and HACCP and they don't realize the importance of infrastructure upgrade for an effective implementation of HACCP. On the other hand, although most of the large industries selected poor infrastructure as a barrier with great impact on GMPs and HACCP implementation, 13 (44 %) didn't assess properly the importance of infrastructure upgrade.

Table 8
Frequency Distribution of Barriers for Implementing Food Safety Management Systems in Descending Order

Barriers	Selected*	Percentage Selected**
Cost	35	70%
Infrastructure and Facilities	21	42%
Lack of Prerequisite Programs	12	24%
Government Infrastructure and Commitment	10	20%
Education and Training of Staff	7	14%

* **The total number of selected barriers might exceed 50 because the individual answering the question was given the choice of choosing three different barriers.**

** **Barriers that were selected with a frequency of less than 10% were not included in the table.**

It's usually assumed that large industries have the needed financial resources and the facilities to perform the needed changes and to attain the HACCP certification.

However, the results of this study show that large industries take cost into consideration even more than the small industries do. Having a larger number of employees and large production scale, the needed improvement in their infrastructures and facilities can be at

high cost and can affect their profitability. However, it seems that the food industries do not recognize the importance of food safety management system in cost reduction on the long term as it was mentioned by WHO (1999).

On the other hand, just 10 (37 %) of small to medium sized industries and 4 (18 %) of the large industries realize the importance of food safety management systems for external markets. This could be related to the lack awareness among the Lebanese food industries due to the lack of support of the Lebanese Government. The results of this study are not with concordance with the results of a similar study in Turkey. 13 (67%) of the 19 food industries in Turkey applying HACCP prefer exporting to EU countries as it's a requirement by the European countries to ensure the safety of the products; while 9 (45%) of the 21 industries not applying HACCP prefer exporting to the Middle East, including Lebanon (CIHEAM, 2007). The lack of governmental commitment, communication and support does not only prevail in the Middle East and near region. In the United States, a gap between the public, government and industry groups was noticed. As such, FDA organized a public meeting to highlight on important issues concerning food safety and to raise awareness about the importance of food safety management systems. Moreover, the public discussion clarified the government's role, public's concerns and dilemmas and the new rules set by the FDA (Taylor, 2013).

2. Type of Industries

The percentages of food industries that selected cost as a barrier were 18 (74%), 11 (73 %) and 10 (80 %) for sweets and chips industries, spirits industries and dairy industries,

respectively. The cluster of sweet industries is in the South. Due to the political conflicts and security issues in this region, the productivity of the industries there has decreased massively (Zaatari, 2013). This will certainly affect the financial capability of such industries. At the same time, the questionnaire was answered just a few days after the most recent attacks in the South. Putting all that in context, cost does form a huge barrier on the sweets, biscuits and chips industries.

As for the dairy production industries that are mostly found in the Bekaa region, most of them are family businesses inherited from ancestors. Furthermore, most of them are small to medium sized industries. Despite their situation, most of them recognized the importance of HACCP implementation to ensure the safety of their products, although they have considered the cost as a barrier.

As for the spirit industries, all those that have participated in the study have stated that their production activity is seasonal and the number of employees is also seasonal. The greatest production is around harvest time, where they employ temporary workers. And they consider HACCP implementation as a financial burden due to the yearly need and cost of training of the workforce. However, 73 % recognized the importance of HACCP implementation to ensure the quality of their products.

3. Location of Industries

The main barriers selected by food industries are: cost, infrastructure and facilities and lack of prerequisite programs, irrespective the size and the location of the industries. Comparing them across the four locations; namely North, South, Bekaa and Mount

Lebanon, over 70% of the industries in each region has chosen cost. All the industries realize that the implementation of prerequisite programs and HACCP require a significant cost which indicates the importance of the governmental commitment and support to be able to implement the food safety management systems in Lebanon.

Those that are inherited need significant cost to change the infrastructure to be able to implement the food safety management systems; that's why cost is considered a main barrier. Regarding the other industries, the big sized and those that already implemented HACCP and food safety management systems, they selected the cost as barrier because they are familiar with the needed requirement to implement or to maintain the food safety management systems in their facilities. Deepananda Herath and Spencer Henson (2005), in their article "Identification and quantification of barriers to HACCP implementation: Evidence from Ontario Food Processing Sector" discussed that associated costs need to be identified so that industries are well informed before adopting HACCP (Herath and Henson, 2005). Once the costs are identified, a strategy is easier to choose, with the help of policy makers and industry organizations (Herath and Henson, 2005). Herath and Henson (2005) believe that if food industries are not committed to adopting HACCP, then they will "unlikely spend time informing themselves and/or exploring the options and associated costs and benefits of HACCP implementation" (Herath and Henson, 2005).

B. Benefits to Implementing Food Safety Management Systems

1. Size of the industries

Aside from the barriers selected, the 27 small to medium sized industries identified three benefits of implementing GMPs and HACCP. The three main selected benefits are improving product quality (40%), opening the product to external markets (37%), and generating customer confidence (33%) as presented in table 6. Moreover, other benefits came forth, namely preventing food poisoning and enhancing reputation of the food industry (Table 6). The benefits chosen are crucial for any industry, but the frequency distribution of these benefits calls for attention. For instance, improving product quality was selected the most; it was selected by 40% of the small to medium industries. This can be interpreted by that these small to medium sized industries have a great interest in improving the product they are producing so that they increase their sales and profit.

In addition, opening the product to external markets is a benefit chosen by 37% of the small to medium industries (Table 6). The small to medium sized industries sell their products in the local markets mostly. The implementation of GMPs and HACCP will surely provide a bigger chance for them to expand and open their products to regional and international markets as well (Shenazi, 2013). Moreover, to become part of external markets, they need to follow an international guideline and implement HACCP and ISO 22000 that all global food industries follow and international markets recognize (Shenazi, 2013).

It's noticed that the majority of the small to medium sized industries didn't recognize the importance of the benefits from the implementation of food safety management systems. As such, an awareness campaign is highly needed and should be conducted by the relevant governmental authorities.

The benefits chosen by the large industries vary from the choices of small to medium sized industries. It is important to mention that each industry had the freedom of choosing three benefits. Out of the 23 large industries, 19 (82%) chose prevention of food poisoning as a benefit (Table 6). And 8 (35%) chose improving product quality as a benefit, while 7 (30%) chose generating customer confidence (Table 6). Looking at the benefits selected by the large industries, their selection is based on the acquired benefits of HACCP or on the food safety knowledge and expertise of the food safety officers. Moreover, just 5 (22%) of the large industries chose acting as a legal defense as one of the benefits from implementing HACCP, and none of the small industries selected this benefit (Table 6). The implementation of food safety management systems is not required by the governmental authorities in Lebanon.

At the same time, the public in Lebanon has become more aware and concerned about the safety and the quality of the food produced in Lebanon (BSI, 2007). Moreover, being exposed to larger markets and a greater number of customers and consumers, food industries need HACCP as a legal requirement to export their products to different countries (BSI, 2007). Being HACCP certified, ensures product quality and generates customer confidence.

2. Type of industries

The most common benefits that were chosen by the industries were preventing food poisoning and improving product quality (Figure 2). More than 50% of each of the sweets industries, dairy industries and beverages industries chose prevention of food poisoning (Figure 2). As for the improvement of product quality, more than 50% of sweets industries, beverages industries chose it as a benefit (Figure 2). More than 50% of the dairy production industries also chose opening the product to external markets as a barrier (Figure 2). The three types of industries, sweets, dairy and beverages, have a more vivid representation on the chart than the rest because they are the types of industries with the greater representation in the study.

The implementation of HACCP does indeed improve the product quality and prevent food poisoning according to the reported studies. HACCP prevents or reduces the food hazards to the acceptable limits through a proper scientific risk analysis of the all the steps of processing (from receiving to delivery) and through the identification of the CCPs and the proper monitoring system. Cordier (1994) mentioned the benefits of HACCP implementation in chocolate industries to control food microbiological hazards, mainly salmonella; the study was conducted after several salmonella outbreaks. Moreover, Schothorst & Kleiss (1994) showed that keeping the production lines in dairy industries well controlled and under sanitary conditions will guarantee the final product's quality and safe consumption. Dairy products are considered potentially hazardous foods and need robust quality assurance systems to ensure the safety of the products in all the steps of production; such as cooling, standardization, pasteurization, followed by fermentation, or

evaporation and drying, or holding and freezing, or sterilization (Schothorst & Kleiss, 1994). In dairy production, identifying the microbiological hazards is crucial. And implementing the HACCP plan has shown great impact on the dairy production industries' records; rarely does an incident occur. Schothorst & Kleiss (1994) emphasize that HACCP studies cannot be replaced or ignored. Adopting the HACCP principles and applying the prerequisite programs will maintain the "very good overall safety record" (Schothorst & Kleiss, 1994) of dairy production industries.

Other benefits selected by the Lebanese food industries were generating customer confidence especially that the Lebanese society is now more aware of food safety issues, especially after the media scandals over the past years. Food industries are now interested in the implementation of HACCP to generate and maintain customer confidence in their products. Also industries interested in external market recognize the importance and need of HACCP implementation to be able to export their products and to gain additional markets. The Lebanese dairy industries and sweets and chips industries were the most interested (Figure 2). This is because most dairy products in Lebanon are local products and their export to regional and international markets is a grand opportunity that all businesses would desire.

3. Location of Industries

Preventing food poisoning, improving product quality and generating customer confidence were the most common benefits selected across all regions. The same benefits have been repeated throughout the study. The location of the industry does not have a direct

effect on the industry's choice of benefits. The size of the industry in the specific location is what alters the distribution of benefits with respect to the location.

In this study, more than 50% of the industries in the Bekaa are of small size and all 4 industries in the North are small sized industries as well. 4 (29%) out of 14 industries in the South are also of small size, while neither of the 2 industries in Mount Lebanon is a small sized industry. The benefits chosen are of vital importance to any industry.

Governments can set policies to guide the industries towards selecting a location for their manufacturing activities when they provide financial support such as loans with low interest to food industries or offer cheap rents (GCSE, 2013). The government's influence also includes tax incentives (GCSE, 2013). The above policies and means of support could influence the selection of the industries locations (GCSE, 2013). Although in Lebanon, more than 60 % of the population resides in Beirut and coastal cities, the majority of the food industries are located in rural areas like Bekaa, South and North of Lebanon. This could be due to the areas where the Lebanese Government has provided tax incentives like in West Bekaa for example or due to other reasons like the price of the properties. Moreover, most of the food industries are inherited family businesses with their current structure passed from one generation to the other. For other food industries, the reason of location selection could be related to the availability of raw materials like wineries, for example.

C. Preferred Supportive Bodies

1. Size of the industries

In Lebanon, an independent food control authority was selected by 13 (49%) of the 27 small to medium sized industries and 17 (74%) of the 23 large industries as an independent governmental authority to support the implementation of food safety management systems. As a second choice, 11 (41%) of the small to medium sized industries chose the private sector as a certifying body, while 13 (57%) of the large industries selected the Ministry of Industry. Less than 10% of the large industries chose any of the remaining Ministries in Lebanon; namely Ministry of Environment, the Ministry of Economy and Trade, and the Ministry of Agriculture. On the other hand, 7 (31%) of the large industries picked the academic sector as a possible body to help the food industries in the implementation of FSMS. Also, large industries didn't prefer to work with current governmental agencies and ministries. This highly indicates the lack of confidence on the current governmental bodies. However, 9 (34%) of small to medium sized industries have selected the Ministry of Agriculture as their choice of certifying body. The other ministries were selected by less than 10% of the small to medium industries.

In India, an independent food authority exists and has been active since 2006. It is called Food Safety and Standards Authority of India (FSSAI) (FSSAI, 2011). The Ministry of Health and Family Welfare is the administrative ministry to execute and implement FSSAI across India (FSSAI, 2011). Another example is the European Food Safety Authority (EFSA) that was organized in 2002 to improve and enhance food safety, as well as to assess risk management (EFSA, nd). It is funded by the EU budget and works

independently and “separately from the European Commission, European Parliament and EU Member States” (EFSA, nd).

2. Type of industries

On the other hand, all the industries, regardless their type, have chosen an independent food authority as a supportive body for the food safety management systems implementation (Figure 5). This independent food authority is meant to be the only body in charge of food control and food regulations in the country. When the authority is given to one specific body across the country, discipline and execution will become much easier. Moreover, other selections were the Ministry of Industry and Private Sector (Figure 5). In Lebanon, for instance, many NGOs and private companies have taken the role of training food production industries and facilities about HACCP; as well as auditing the work environment to monitor its implementation (NDU, 2010).

In addition, it is important to mention that Lebanon does not have a food safety law yet (AUB, 2012). Even though a food safety law proposal was presented in 2004, declaring the “establishment of a single government institution to govern all food safety stakeholders and adopt risk analysis for assessment, management and communication” (Kamleh et al, 2012); the council of ministers did not discuss it before 2006. On top of that, no action has still been taken and the proposal still stands (Kamleh et al, 2012). This might explain the reason why the different ministries were not selected as preferred certifying/ supportive bodies. The cluster of choices was between the independent food authority and the private sector (Figure 5). This indicates the lack of confidence in the current governmental institutions involved in food control.

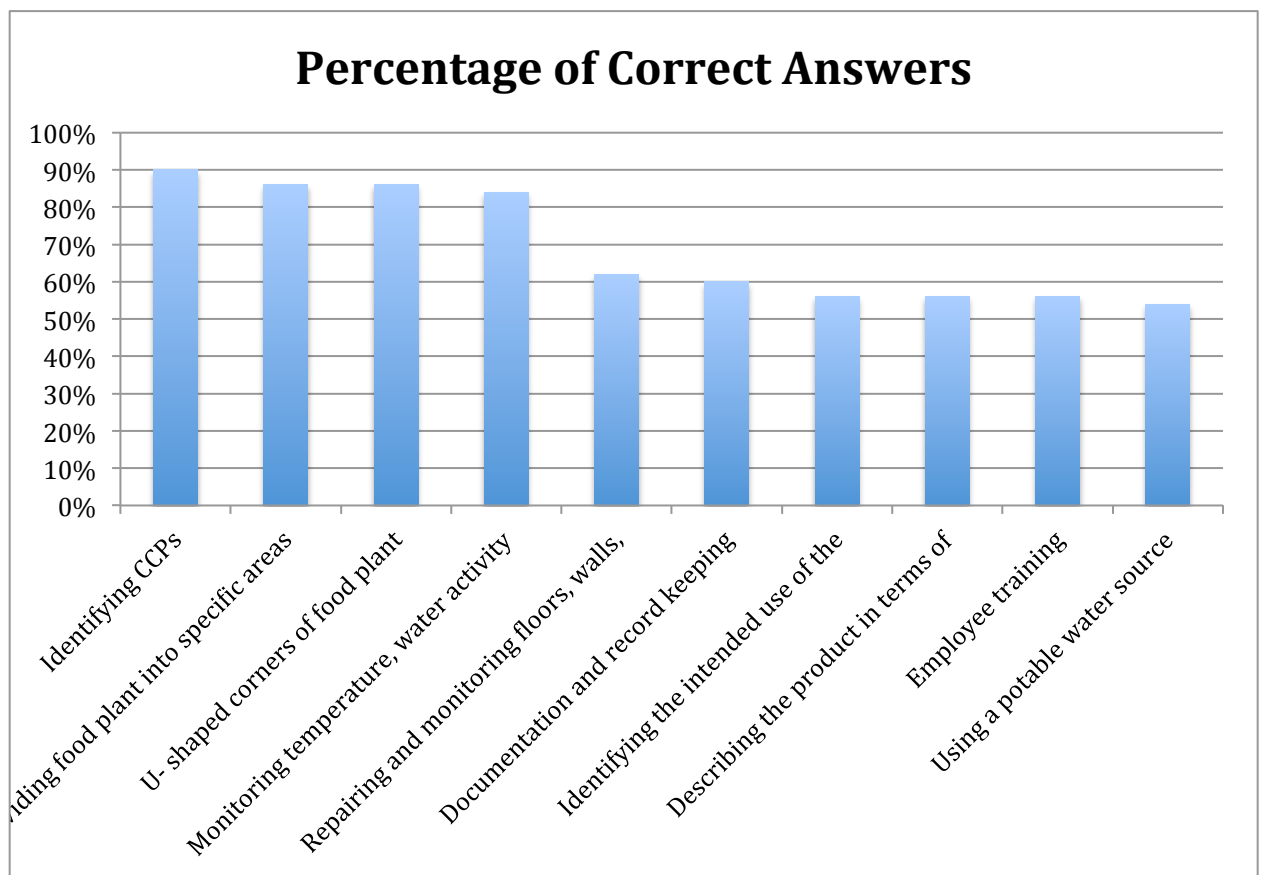
D. Training and Knowledge Assessment

The knowledge about GMPs and HACCP principles was also assessed through the administered questionnaire among different food industries. The results showed that 45 (90%) industries recognized that identifying CCPs is part of HACCP while all other principles were identified correctly by only 27 (55%) industries (Figure 6). This shows the lack of knowledge among food safety officers regarding the other principles. In addition, three GMP entities were identified correctly by 43 (86%) industries; namely, dividing the food plant into specific areas, having U-shaped corners and monitoring the temperature and water activity (Figure 6). Employee training got one of the lowest scores (56%), which indicates that 44 % of the food safety officers do not recognize the importance of training as a prerequisite for HACCP implementation and the need of technical trainings for an effective HACCP implementation. Moreover, 56% of the directors have a university degree while 10% have a Masters degree and 42% of the food safety officers have a university degree while 6% have a Masters Degree (Table 2). On the other hand, 22% of the directors and 52% of the food safety officers did not answer this question (Table 2). The majority of the directors and food safety officers with high educational levels are employed in large industries, while those with minimal or no education, are employed at small to medium sized industries. As indicated before, small to medium sized industries are mostly family businesses that have been handed down from one generation to the other, based on job acquired experience grasped on the job. So education and specialization in food quality control was not considered a priority. However, the industries of a large scale and of international or regional markets are those that are concerned with university degrees and

higher education. In addition, the implementation of GMPs and HACCP in such industries could not have occurred without the expertise and knowledge of food safety officers.

Figure 6

Percentages of Correct Answers Concerning Familiarity of GMPs and HACCP from Highest to Lowest Percentage (Question 18 of Questionnaire)



On the other hand, the barriers for implementing HACCP in large industries in UAE are also the “availability of appropriate training in HACCP methodology and access to technical expertise” (Shenazi, 2013). These problems are similar to those observed in the

industries in Lebanon. This also magnifies the cost barrier that the sample group has chosen. Moreover, Shenazi (2013) emphasizes that small food and beverage industries are not the only ones facing difficulties when implementing HACCP. In addition to the problems mentioned, the UAE has the language as a barrier in large industries that hinders the training and the adaptation of HACCP in the food chain (Shenazi, 2013). This might be a problem in small industries located in Lebanon in comparison to the large industries that have been exposed to international markets.

In the same context, Manta (2013), an online community that is dedicated to helping small industries grow and expand through connecting, buying or joining other companies or industries, has publicly reported that “Experience Trumps Education”. Rita Lobo (2013), a journalist of the *New Economy*, reported that Manta meant to “weigh-in on the enduring debate of the cost-benefit value of attending a college or university, because of rising tuition costs “ (Lobo, 2013). The results of the study conducted by Lobo (2013) on 978 small to medium businesses in the United States, showed that half of them employ individuals without a university degree (Lobo, 2013). Over 60% of the 978 businesses reported that they don’t see a difference in the performance between those who have a university degree and those who don’t (Lobo, 2013). Lobo (2013) continues to affirm that 70% of the small business owners have University degrees or higher educational levels; and while over 60% of them believe that a university degree is a necessity, less than 30% declare that a degree has no value.

In Lebanon, the majority of the directors in the sample group have a University degree while less than half of the food safety officers do not (Table 2). In addition, the

small to medium sized businesses are, as mentioned before, family businesses. So, if an opportunity does not present itself to the family member, an education does not seem crucial since a job and career are already ready for them. However, whenever the HACCP will be a legal requirement, all the food industries will need a food safety officer with the required technical and scientific expertise for a proper implementation.

Moreover, as the HACCP plan is a holistic plan that deals with all aspects of food handling, processing, storing and consuming, staff training is listed in the guidelines as prerequisite programs for adopting it (FDA, 2013). It is vital that the food handlers understand HACCP and learn how to identify the CCPs and control them (FDA, 2013). Staff training is also responsible of developing the skills of the employees so that the HACCP plan functions properly (FDA, 2013).

Staff training was not selected by most of the large industries and small to medium sized industries. In the list of barriers, resistance to change was not selected by either small or large industries. The food handlers and the management team have to be trained on the GMPs and the HACCP guidelines and principles for a successful and effective implementation of such food safety management systems in the food industries. Without the proper implementation, food quality and safety will be at risk. The WHO (1999) report defined lack of staff training as one of the human resource constraints. “Lack of management commitment and understanding of HACCP” are major human resource barriers that may lead to a low perception of risks and absence of food safety (WHO, 1999). In addition, the report mentions that food quality and safety are dependent on the time devoted to understand HACCP, the turnover rate of the staff, and the lack of expertise

and training of the employees and staff (WHO, 1999). The WHO (1999) report also mentions that enough training is crucial to overcome the human resource barriers regarding GMP and HACCP implementation.

Looking at the choice of benefits of the study sample, none of them selected the training of staff as a benefit (Table 9). On the other hand, when looking at the barriers selected, 7 (14%) industries chose education and training of the staff and 5 (10%) industries selected awareness and expertise of staff (Table 8). It's clear that the food industries do not recognize the importance of staff training for an effective HACCP implementation. The Lebanese industries, as presented before, have minimal consideration of integrating their staff and employees into the system. An industry cannot expect the HACCP plan to be effective and beneficial unless everyone is included and alert of his roles and responsibilities. The training of employees and staff will target the needed skills to be improved or acquired and execute them efficiently (Ekot, 2010).

In conclusion, no matter the size of the industry or the number of workers, the main concern of industries in Lebanon is the product's importance in the market. HACCP is a system that will boost their product and the profit that comes with it. However, HACCP is a holistic plan that includes all processing chains, all issues and all personnel. So the staff is part of HACCP; they are the handlers of the food, raw material and packaging. It is important that they understand what their role is and the purpose behind implementing HACCP.

Table 9
Frequency Distribution of Benefits for Implementing Food Safety Management Systems in Descending Order

Benefits	Selected*	Percentage Selected**
Prevents Food Poisoning	26	52%
Improves Product Quality	19	38%
Generates Customer Confidence	16	32%
Opening Product to External Markets	14	28%
Enhances Reputation	6	12%
Creates Discipline	5	10%
Acts as Legal Defense	5	10%

***The total number of selected benefits might exceed 50 because the individual answering the question was given the choice of choosing three different benefits.**

**** Benefits that were selected with a frequency of less than 10% were not included in the table.**

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

A. Conclusion

Food hazards that might contaminate the foods in the process chain are mainly a result of poor practices and absence of control starting from the preparation stage, production to delivery. Based on scientific risk analysis, HACCP is the food safety management system that helps in identifying the control points to prevent or reduce the hazards to acceptable levels to minimize health risks and avoid economic loss (Ball et al, 2009). As such, a study to identify the specific barriers that Lebanese food industries face in implementing the GMPs and HACCP is of great importance in order to diagnose the problem and propose the appropriate interventions to ensure a long term and lasting food safety system in Lebanon. This is in line with the proposed food safety law in Lebanon that recommends the implementation of preventive food safety management systems in all food establishments. The outcome of this research study will certainly help in a successful execution of the proposed regulations. In addition, it will also enable the Lebanese food industries to recognize their strengths and weaknesses for a “smooth” implementation. It will also help the Lebanese authorities in identifying gaps that require their attention and concern.

The main barriers and benefits of implementing GMPs and HACCP in the Lebanese food industries” are as follows:

- Large sized industries are much more aware than the small to medium sized industries when it concerns food safety management systems; namely HACCP and GMPs.
- The different types of the industries play an important role in choosing different barriers and benefits concerning GMPs and HACCP.
- The location of the industries does not have a direct impact on the choices of barriers and benefits of implementing GMPs and HACCP, but all regions suffer from cost as a barrier.
- The major barriers of implementing GMPs and HACCP in Lebanese food industries are the cost, lack of prerequisite programs, and poor infrastructure and facilities.
- The major benefits of implementing GMPs and HACCP in Lebanese food industries differ in large industries than in small to medium sized industries: small to medium sized industries focus on expanding the products’ markets and improve the product image to customers. Large industries focus on improving the product quality and preventing food poisoning incidents. Both groups of industries want to generate customer confidence.
- Absence of government involvement and support is noticed throughout the study.
- The exclusion of staff involvement and training is also noticed eventhough several industries chose lack of expertise and knowledge of staff as barriers.

- For a supportive and certifying body, an independent authority is of great favor to the Lebanese food industries.
- Knowledge of the food safety officers and directors is a combination of experience in the food production business and relevant education about the field.

B. Recommendations

- The Lebanese government must adopt the proposed food safety law to implement consistent food safety practices in all food industries across Lebanon.. Enforcement can occur through incentives fines and inspections.
- An independent food control authority is the best solution to control, train and guide the Lebanese food industries through the HACCP implementation and execution. The different Ministries are not preferred by the majority of the Lebanese food industries, as the study shows.
- A thorough assessment of the infrastructure and facilities of the food industries must take place, since it was one major barrier. Financial support for small to medium sized industries is needed to be able to execute the needed changes. Such financial support can be offered through long term loans with low interest rate and other incentives like tax reduction.
- Before applying GMPs and HACCP, the managerial team, food safety officers and handlers, employees and staff must all be involved in the training, understanding and executing of the food safety management system.

- Help the food industries focus on the benefits of implementing GMPs and HACCP. Through training, HACCP's cost efficiency on the long run is important to explain for maintaining commitment.
- Cooperation between the Lebanese government, food industries and the academic sector (educational and research institutions) can shape a strategy for awareness campaigns and effective implementation of food safety management systems in the food chain.

Appendix

Table 10
Frequency Distribution of Familiarity of Food Safety Officer about GMPs and HACCP

Familiarity	N=50	Percentage Total
Familiarity Level of GMPs		
Great to some extent	45	90%
Little to no extent	5	10%
Familiarity Level of HACCP		
Great to some extent	45	90%
Little to no extent	5	10%
Familiarity Level of ISO 22000		
Great to some extent	44	88%

Little to no extent	6	12%
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Table 11

Frequency Distribution of Familiarity of Food Safety Officer about the principles of HACCP and entities of GMP

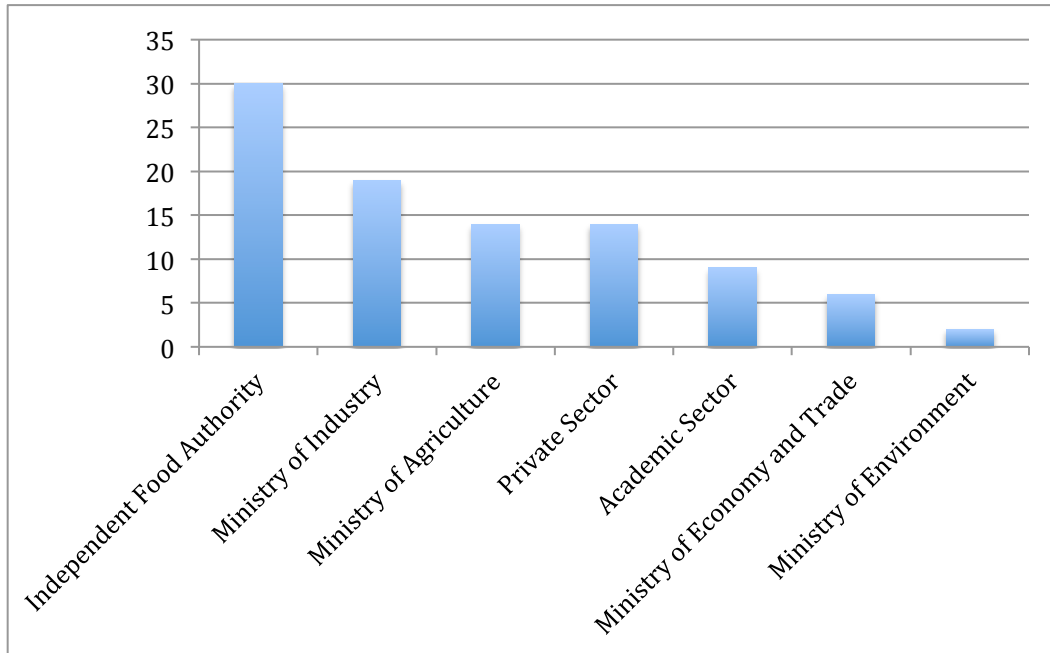
	Number of Industries (N=50)	Percentage Total
Familiarity Level of HACCP Principles		
Great to some extent	35	70%
Little to no extent	15	30%
Familiarity Level of GMP entities		
Great to some extent	33	66%
Little to no extent	17	34%

Table 12
 Knowledge about GMPs and HACCP in relation to the extent of knowledge about their principles

Familiarity of entities/ principles		
Knowledge Extent	Great to some extent	Little to no extent
GMP		
Great to some extent	33	12
Little to no extent	0	5
HACCP		
Great to some extent	35	10
Little to no extent	0	5

Figure 7

Frequency Distribution of Preferred Selected Bodies to Help the Industries implement HACCP in Descending Order



*** The total number of selected bodies might exceed 50 because the individual answering the question was given the choice of choosing three different bodies.**

Administered Questionnaire in English**Part I: Demographics and General Information on Food Industry**

1. Address of the industry: _____
2. Number of employees: _____
3. Number of departments: _____
4. Number of directors/managers: _____
5. Educational levels of directors/managers: _____
6. Food safety officer's educational level: _____
7. Food safety officer's years of work experience (in the field of food safety and quality assurance): _____

8- Which type of food industry does your organization belong to:

- | | |
|--|---|
| a- Dairy Products | d- Coffee and Nuts |
| b- Beverages and Spirit | e- Biscuits, chocolates, sweets, potato chips |
| c- Oil and Fat Products | f- Processed foods and canning |
| g- Meat and poultry processed products | |
| h- Salt, herbs, spices | |
| i- Mineral water sector | |

9- Main Product(s) Market(s):

- a-Lebanese b- Regional c- International

10- Does your organization follow a food safety management system?

- Yes No

Part II: Attitude towards Implementing a Food Safety Management System

11- Please rank your familiarity with the following international voluntary management systems using the following scores:

1= familiar to great extent 2= familiar to some extent 3= familiar with little extent
4= not familiar

GMP	1	2	3	4
HACCP	1	2	3	4
ISO 22000	1	2	3	4

12- Has your industry acquired one or more of the following certifications?

- HACCP Yes No
- ISO 22000 Yes No

13- if not certified to both HACCP and ISO 22000, do you have any plans in the future to apply for any of the above certifications?

- Yes **(if yes, go to question 14)**
- No **(if no, skip to question 15)**
- No idea **(if no, skip to question 15)**

14- Please state the reasons for future implementation of HACCP or ISO 22000.
(Skip to question 16)

15- Please state the reasons for not implementing HACCP or ISO 22000 in the future.

Part III: Knowledge concerning the GMPs and HACCP

16- Please rank your familiarity with the principles of HACCP using the following scores:

1= familiar to great extent 2= familiar to some extent 3= familiar with little extent
4= not familiar

17- Please rank your familiarity with the entities of the Good Manufacturing Practices using the following scores:

1= familiar to great extent 2= familiar to some extent 3= familiar with little extent
4= not familiar

18- Below is a list of requirements that fall under Good Manufacturing Practices and others that fall under HACCP guidelines. Kindly indicate the corresponding food safety system of each of the items in the list.

List	GMPs	HACCP
Dividing food plant into specific areas		
U- shaped corners of food plant		
Identifying CCPs		
Monitoring temperature, water activity and pH as critical limits		
Employee training		
Using a potable water source		
Documentation and record keeping		
Repairing and monitoring floors, walls, and ventilation		
Identifying the intended use of the product		

Describing the product in terms of composition, storage conditions and packaging		
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Part IV: Benefits of Implementing GMPS and HACCP

19- Below is a list of global benefits of implementing GMPs and HACCP in a food plant. Kindly choose **three** benefits from the list and rank them according to importance.

Where, 1= greatest importance 2= second in importance 3= least importance

Ranking

- a- Prevents food poisoning _____
- b- Reduces number of complaints _____
- c- Acts as a legal defense against complaints _____
- d- Complies with local legislation _____
- e- Complies with international legislation _____
- f- Generates customer confidence _____
- g- Reduces industry costs _____
- h- Creates discipline _____
- i- Assures staff training _____
- j- Improves product quality _____
- k- Enhances reputation _____
- l- Product becomes open to external market _____
- m- Other Specify: _____ _____

Part V: Practices of Food Safety in Your Food Industry

20- Please specify whether the food safety practices listed below are adopted by your organization or not.

a- Implementing basic hygiene practices	Yes	No
b- Carrying out routine checks	Yes	No
c- Controlling temperature	Yes	No
d- Avoiding cross contamination	Yes	No
e- Regular training of employees	Yes	No
f- Have regular seminars and lectures	Yes	No
g- Check the quality and safety of raw materials	Yes	No
h- Other Specify: _____	Yes	No

Part VI: Possible Barriers that Prevent the Food Industry from Adopting GMPs and HACCP

21- What is your perception regarding the level of difficulty to obtain HACCP certification?

- a- Easy b- Medium c- Difficult d- No idea

22- What is your perception regarding the cost to obtain HACCP certification?

- a- Low cost b- Medium cost c- High cost d- No idea

23- Below is a list of global barriers of implementing GMPs and HACCP in a food plant. Kindly choose **three** barriers from the list and rank them according to importance.

Where, 1= greatest importance 2= second in importance 3= least importance

	<u>Ranking</u>
a- Lack of prerequisite programs	—
b- Infrastructure and facilities	—
c- Awareness and expertise of staff	—
d- Education and training of staff	—
e- Technical support	—
f- Cost	—
g- Resistance to change	—
h- Government infrastructure and commitment	—
i- Excessive paper work and documentation	—
j- Other Specify: _____	—

Part VII: Incentives to Adopt GMPs and HACCP Certification

24- Do you believe that adopting a food safety management system will open regional and external markets to their products?

Yes No

25- Below are factors that support HACCP certification. Kindly indicate whether these factors support HACCP certification in your organization or not.

- a- Special tax exemption for HACCP and ISO 22000 certification
Yes No
- b- Enhancing knowledge on GMPs and HACCP
Yes No
- c- Training and capacity building for food industry personnel
Yes No
- d- Establishing consultant services
Yes No
- e- Provision of loans to industries planning on adopting GMPs and HACCP certification
Yes No
- f- More collaboration programs between the government and the private sector
Yes No
- g- Establishing policies to encourage the adoption of GMPs and HACCP
Yes No

26- Please choose three (at most) relevant bodies that can help your food industry acquire HACCP certification

- a- Ministry of Industry
- b- Ministry of Environment
- c- Ministry of Agriculture
- d- Ministry of Economy and Trade
- e- Private sector (NGOs)
- f- Academic sector (Universities, Professors, Researchers)
- g- Independent food authority
- h- Other Specify: _____

THANK YOU FOR YOUR COOPERATION

Administered Questionnaire in Arabic

الجزء الأول: معلومات عامة وإحصائيات سكانية في الصناعات الغذائية

1. عنوان المؤسسة الصناعية:

2. عدد الموظفين: _____

3. عدد الإدارات: _____

4. عدد المدراء / المديرين: _____

5. المستويات التعليمية للمديرين / المدراء: _____

6. المستوى التعليمي لضابط السلامة الغذائية: _____

7. سنوات من الخبرة في مجال سلامة الأغذية وضمان الجودة لضابط السلامة الغذائية :

8. إلى أي نوع من الصناعات الغذائية تنتمي منطقتكم:

ب المشروبات والكحول

أ منتجات الألبان

د منتجات القهوة والمكسرات

ج منتجات الزيوت والدهون

و- أطعمة مصنعة ومعلبة

هـ البسكويت والشوكولاتة والحلويات ورقائق البطاطا

ح- ملح و أعشاب وتوابل

ز منتجات اللحوم والدواجن المصنعة

ط قطاع المياه المعدنية

9 السوق (الأسواق) الرئيسي(ة) للمنتج (المنتجات):

ج دولية

ب اقليمية

أ لبنانية

10- هل تتبع مؤسستك نظام إدارة السلامة الغذائية؟

كلا

نعم

الجزء الثاني: الموقف من تنفيذ نظام لإدارة السلامة الغذائية

11 يرجى ترتيب معرفتكم مع النظم الإدارية الدولية الطوعية التالية باستخدام التالي:

1 = مألوفة إلى حد كبير 2 = مألوفة إلى حد ما 3 = مألوفة إلى حد بسيط 4 = غير مألوفة

4	3	2	1	GMP
4	3	2	1	HACCP
4	3	2	1	ISO 22000

12 هل حصلت الصناعة الخاصة بكم على واحد أو أكثر من الشهادات التالية؟

HACCP نعم كلا

ISO 22000 نعم كلا

13 في حال عدم حصولكم على أي من الشهادتين، هل لديكم أية خطط مستقبلية لتطبيق لأي من الشهادات أعلاه؟

نعم (إذا كان الجواب نعم، انتقل إلى السؤال 14)

لا (إذا كانت الإجابة لا، انتقل إلى سؤال 15)

لا فكرة (في هذه الحالة، انتقل إلى سؤال 15)

14- يرجى ذكر الأسباب لتطبيق HACCP و ISO 22000 في المستقبل

(انتقل إلى السؤال 16)

15 يرجى ذكر الأسباب لعدم تنفيذ HACCP أو ISO 22000 في المستقبل

الجزء الثالث: المعرفة المتعلقة بنظامي HACCP و GMP

16 يرجى ترتيب معرفتكم مع مبادئ HACCP باستخدام التالي

1 = مألوفة إلى حد كبير 2 = مألوفة إلى حد ما 3 = مألوفة إلى حد بسيط 4 = غير مألوفة

17 - يرجى ترتيب معرفتكم بكيانات GMP باستخدام التالي:

1 = مألوفة إلى حد كبير 2 = مألوفة إلى حد ما 3 = مألوفة إلى حد بسيط 4 = غير مألوفة

18 فيما يلي قائمة من المتطلبات التي تندرج تحت GMP وغيرها التي تقع في إطار مبادئ HACCP.

يرجى الإشارة إلى نظام السلامة الغذائية المقابل لكل من العناصر الموجودة في القائمة.

HACCP	GMP	القائمة
		تقسيم المصنع إلى مساحات محددة
		زوايا مصنع الأغذية على شكل U
		تحديد نقط التحكم الحرجة CCPs
		رصد درجات الحرارة وحركة المياه و درجة الحموضة كحدود حرجة
		تدريب الموظفين
		التوثيق وحفظ السجلات
		إصلاح ورصد الأرضيات والجدران والتهوية
		تحديد الاستخدام المقصود للمنتج
		وصف المنتج من حيث تكوينها وظروف التخزين والتعبئة والتغليف

الجزء الرابع: فوائد تنفيذ GMPS و HACCP

19 فيما يلي قائمة من الفوائد العالمية لتنفيذ GMPs و HACCP في المصانع الغذائية. يرجى اختيار ثلاث فوائد من القائمة وتصنيفها حسب الأهمية حيث:

=1 أهمية قصوى =2 ثمانية من حيث الأهمية =3 الأقل أهمية

تصنيف

_____	1 يمنع التسمم الغذائي
_____	ب يقلل من عدد الشكاوى
_____	ج يعمل كدفاع قانوني ضد الشكاوى
_____	د يتوافق مع التشريعات المحلية
_____	ه يتوافق مع التشريعات الدولية
_____	و يولد ثقة العملاء
_____	ز يقلل من تكاليف الصناعة
_____	ح يخلق الانضباط
_____	ط يؤكد على تدريب الموظفين
_____	ك يحسن جودة المنتج
_____	ل يعزز السمعة
_____	م يصبح المنتج مفتوحا أمام السوق الخارجية
_____	ن أخرى حدد: _____

الجزء الخامس: ممارسات سلامة الأغذية في صناعة الأغذية الخاصة بك
20 يرجى تحديد ما إذا كان يتم اعتماد ممارسات سلامة الأغذية المدرجة أدناه في مؤسستك أم لا

لا	نعم	أ تطبيق الممارسات الصحية الأساسية
لا	نعم	ب يقومون بأعمال تفتيش روتينية
لا	نعم	ج التحكم في درجة الحرارة
لا	نعم	د تجنب التلوث المتبادل أو العرضي
لا	نعم	هـ تدريب دوري للموظفين
لا	نعم	و توفر الندوات والمحاضرات الدورية
لا	نعم	ز التحقق من جودة وسلامة المواد الأولية
لا	نعم	ح أخرى حدد: _____

الجزء السادس: الحواجز التي يمكن أن تحول دون اعتماد الصناعات الغذائية لأنظمة HACCP و GMP

21 ما هو التصور الخاص بكم فيما يتعلق بمستوى صعوبة الحصول على شهادة HACCP؟

أ سهلة ب متوسطة ج صعبة د لا فكرة

22 ما هو التصور الخاص بكم فيما يتعلق بتكلفة الحصول على شهادة HACCP ؟

أ منخفضة التكلفة ب متوسطة التكلفة ج تكلفة مرتفعة د لا فكرة

23 فيما يلي قائمة من الحواجز العالمية لتنفيذ GMP و HACCP في المصانع الغذائية. يرجى اختيار ثلاثة حواجز من القائمة وتصنيفها حسب الأهمية.

=1 أهمية قصوى =2 ثانياً من حيث الأهمية =3 الأقل أهمية

تصنيف

أ نقص في البرامج المسبقة

ب البنية التحتية والمرافق

ج وعي وخبرة الموظفين

د ثقافة الموظفين وتدريبهم

ه الدعم الفني

و التكلفة

ز مقاومة التغيير

ح البنية التحتية للحكومة ومدى التزامها

ط الإفراط في العمل المكتبي والتوثيق

ك أخرى حدد: _____

الجزء السابع: حوافز لاعتماد شهادة HACCP وGMP

24 هل تعتقد أن اعتماد نظام إدارة السلامة الغذائية ستفتح الأسواق الإقليمية والخارجية لمنتجات مؤسستكم؟

نعم كلا

25 فيما يلي العوامل التي تدعم شهادة HACCP . يرجى الإشارة إلى ما إذا كانت هذه العوامل تدعم شهادة HACCP في المؤسسة الخاصة بك أم لا.

أ الإغفاء الضريبي الخاص لشهادتي HACCP و ISO 22000

نعم كلا

ب تعزيز المعرفة بشأن HACCP وGMP

نعم كلا

ج التدريب وبناء القدرات للعاملين في الصناعات الغذائية

نعم كلا

د تأسيس الخدمات الاستشارية

نعم كلا

ه توفير القروض للصناعات العازمة على اعتماد شهادات HACCP و GMP

نعم كلا

و برامج تعاون أكثر بين الحكومة والقطاع الخاص

نعم كلا

ز وضع سياسات لتشجيع اعتماد HACCP وGMPs

نعم كلا

26 يرجى اختيار ثلاث (على الأكثر) هيئات ذات الصلة التي يمكن أن تساعد الصناعة الغذائية الخاص بكم للحصول

على شهادة HACCP

أ وزارة الصناعة

ب وزارة البيئة

ج وزارة الزراعة

د وزارة الاقتصاد والتجارة

ه القطاع الخاص (المنظمات غير الحكومية)

و القطاع الأكاديمي (الجامعات والأساتذة والباحثون)

ز- سلطات غذائية مستقلة

ح أخرى حدد: _____

نشكر تعاونكم

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