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Food Hygiene and Safety Among Cake Bakeries in Gaza Governorate

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Food Hygiene and Safety Among Cake Bakeries in Gaza Governorate

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Dedication

To my late father and to my dearest mother, brothers and sisters.

To my beloved wife, and children.

To my friends.

To my colleagues

Bashir Ahmed Mourad

Declaration

I certify that this thesis submitted for the degree of Master of Public Health is the result of my own research, except where otherwise acknowledged, and that this thesis has not been submitted for a higher degree to any other university or institution.

Signature:

Bashir Ahmed Mourad

Date: 1-3-2009

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Abstract

Cake is considered as a perishable food with high risk of exposure to microbial contamination where it contains (milk and eggs), which may be introduce microbial pathogen at some point along the food chain. Across sectional study was used to assess food hygiene and safety among cake bakeries in suburbs of Gaza Governorate. Ninety questionnaire interviews were conducted with cake workers in cake making plant in Gaza Governorate during the period from January to July 2008. In addition 173 cake samples were collected for microbial analysis from cake making plant in the same period. The microbial analysis was carried out in ministry of health food and water laboratory for total bacterial count, S. aureus, coliforms, E-coli, mold and O.lacts. The questionnaire results showed the mean age of the study population was 29.9 years. Workers experience and training represents 58.9% and 42.2%, respectively. A total of 70 (77.8%) workers had medical examination. There was a good hygiene practice in respect to hand washing. Seventy four (82.2%) workers mentioned that workers, tools, ingredients are the source of microbial contamination. Workers who had knowledge about microbial food spoilage were 81 (90.0%). Seventy seven (85.6%) workers checked the primary ingredients when receiving before accepting. 79 (87.8%) cake workers stated that pest control is applied in the plant. Concerning disinfections of tools and equipments, 54 (60.0%) workers made disinfection. A total of 74 (82.2%) workers used containers with well closed lid. Seventy two (80.0%) workers claimed that the plants are licensed. Most workers 54 (60.0%) reported that the plant is mainly inspected by the Ministry of Health. Microbial analysis showed that the number of contaminated samples 148 (85.5%), 30 (17.3%), 94 (54.3)%, 29 (16.8%), 20 (11.6%) and 11 (8.7%) with TBC, S. aureus, coliforms, E-coli, mold and O. lacts respectively. However, the number of the samples which considered unacceptable according to microbial limits 24 (13.9%), 29 (16.8%), 55(31.8%) and 29 (16.8%), TBC, S. aureus, coliforms, E-coli respectively. The means of 173 samples tested 1.01e5, 635.8, 1.01e4, 1157.8, 92.49 and 135.3 for TBC, S. aureus, coliforms, E-coli, mold and O. lacts respectively. Whereas all the means higher than their microbial limits. One sample T test revealed that most of the mean difference was statistically significant P value less than 0.05. The means of 81 samples tested in winter 4.94e4, 256.8, 4198.8, 128.4, 55.6 and 112.4 for TBC, S.aureus, Coliforms, E.coli, mold and O.lacts; respectively, in addition 92 samples were tested in summer, the means were 1.47e5, 969.6, 1.53e4, 2064.1, 125.0 and 155.4 respectively. All the means of microbes were higher in summer than the microbial

means in winter. The difference between the means related to high temperature in summer than winter which suitable temperature for microbial growth. Those results show the necessitates that workers should be trained in the filed of food safety before getting the work, the authority of food safety should emphasis on implementing HACCP in cake plant and Palestinian cake standard should be established.

ملخص الرسالة

صحة وسلامة الغذاء (الجاتوه) في معامل الجاتوهات في محافظة غزة

الهدف الرئيسي للدراسة تقييم صحة وسلامة الغذاء (الجاتوه) بمعامل الجاتوه في أحياء محافظة غزة. حيث تم تعبئة 90 استبانه بالمقابلة الشخصية مع العمال بمعامل الجاتوه خلال الفترة من يناير حتـــى يوليـــو2008. وتـــم تحليـــل ميكروبي لعدد 173 عينه جاتوه جمعت من معامل الجاتوه بمحافظة غزة حيث تم إجراء فحـــص العـــد البكتيـــري ،الإستافيلوكوكس، مجموعة الكوليفورم، الاشرشيا كوليفورم، الفطريات، وفطر الأولكتس. متوسط عمر العاملين في هذا المجال 29.9 سنة. خبرة العاملين وتدريبهم كان 98.9% ، 42.2% من مجموع العينة. وبخـــصوص صـــحة العاملين أوضحت الدراسة أن (77.8%)70 قاموا بعمل الفحوصات الطبية الروتينية.غالبية العمـــال (77.8%)70 أفادوا بأن الميكروبات ضارة. (82.2%)74 من العاملين أشاروا بأن تلوث الجاتوه سببه العمال، الأدوات والمـــواد الخام الأولية. (90%)81 من العمال لديهم معرفة عن فساد الغذاء و(85.6%)77 من العمال يقوموا بفحص المواد الخام الأولية عند الاستلام قبل قبولها. (87.8%)79 من عمال الجاتوه أفادوا بأنهم يطبقون مكافحة الحشرات داخـــل المصانع التي يعملون بها. وبخصوص تطهير الأدوات والمعدات (60%)54 منهم يقومون بذلك. (82.2%)47 من العمال يستخدمون أوعية خاصة للنفايات محكمة الإغلاق. (68.9%)62 يقومون بتخزين المنتج النهـــائي والمـــواد الأولية في ثلاجات منفصلة. (80%)72 من العمال أشاروا بأنهم يعملون في مصانع مرخصة.

بخصوص التحليـــل الميكروبـــي أظهـــرت النتـــائج أن عـــدد العينـــات الملوثـــة (85.5%)148، (17.3%)30، (54.3%)94، (16.8%)29، (11.6%)20 و (8.7%)11 بالعـــد الميكروبـــي، الإســـتافيلوكوكس، مجموعـــة الكوليفورم، الاشرشيا كوليفورم، الفطريات و فطر الأولكتس على التوالي. ومع ذلك فإن عدد العينات التـــي تعتبـــر غير مقبولة حسب الحدود الميكروبيـــة المـــسموحة (13.9%)24، (16.8%)29، (31.8%)55، و (16.8%)29 بالعد الميكروبي، الإستافيلوكوكس، مجموعة الكوليفورم، الاشرشيا كوليفورم، الفطريات و فطـــر الأولكـــتس علـــى التوالي. حيث أظهرت الدراسة بأن متوسط 173 عينـــة التـــي فحـــصت 1.01e5، 635.8، 1.01e4، 1157.8 ، 92.49 و 135.3 للعد الميكروبي، الإستافيلوكوكس، مجموعة الكوليفورم، الاشرشيا كوليفورم، الفطريات و فطـــر الأولكتس على التوالي. حيث أن كل المتوسطات كانت أعلى من حدودها الميكروبية المسموحة لها و عند اســـتخدام

one sample T test أظهرت بأن الاختلافات ذات دلالة إحصائية معنوية حيث أن قيمة P أقل مـــن 05. وكـــان متوسط 81 عينه فحـــصت فـــي فـــصل الـــشتاء 4.94e4، 256.8، 4198.8، 128.4، 55.6 و 112.4 بالعــد الميكروبي، الإستافيلوكوكس، مجموعة الكوليفورم، الاشرشيا كوليفورم، الفطريات و فطر الأولكتس علـــى التـــوالي بالإضافة إلى 92 عينه فحصت في فصل الـــصيف كانـــت المتوســـطات 1.47e5، 969.6، 1.53e4، 2064.1، 125.0 و 155.4 على التوالي. وأظهرت النتائج أن كل المتوسطات كانت أعلى في فصل الصيف عنها في فـــصل الشتاء وهذا الاختلاف في المتوسطات يرجع إلى ارتفاع درجة الحرارة في فصل الصيف حيث تكون مناسبة للنمـــو الميكروبي عنها في فصل الشتاء.

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LIST OF ABBREVIATIONS

°C	Degree centigrade (Temperature)
CDC	American - Centre for Diseases Control and Prevention
FDA	American - Food and Drug Administration
FAO	Food Agriculture Organization
GHP	Good Hygiene Practices
GMP	Good Manufacturing Practices
MOH	Ministry of Health
MONE	Ministry of National Economy
PHC	Primary Health Care
No.	Number
SPSS	Statistical package for the social sciences for data cleaning and analysis
WHO	World Health Organisation
LAB	Laboratory
CI	Confidence Interval
O.R	Odds Ratio
pH	Acidity
CAC	Codex Alimentarius Commission
RCP	Recommended International Code of Practice
TBC	Total bacteria count
E-coli	Escherichia coli
Staph.	staphylococcus
O.lacts	Oidium Lactis
Std.	Standard deviation
PAHO	Pan American Health Organization

Definitions

Bacteria: living single –cell organisms. Water, wind, insects, plants, animals and humans can carry bacteria, which can thrive on skin, clothes and in human hair, as well as in scabs, scars, the mouth, nose. Throats, intestines, and room-temperature foods (PAHO and WHO, 2001).

Cleaning: the removal of soil, food residue, dirt, grease or other objectionable matter (Codex, 2003).

Codex Alimentarius Commission: the Codex Alimentarius Commission was created in 1962 in a joint FAO and WHO conference about regulations with the objective of establishing a combined FAO/WHO program based on those regulations. Currently, the Commission has more than 153 member countries that represent almost 97% of world's population. The Codex Alimentarius create food rules, and guidelines to be followed by the international community as established, with the purpose of protecting consumers, health and ensuring uniform international trade practices (PAHO and WHO, 2001).

Contaminant: Any biological or chemical agent, foreign matter, or other substances not intentionally added to food, which may compromise food safety or suitability (Codex, 2003).

Cross- contamination: Is the transmission of a biological, chemical, of physical hazard to a food through dirt, cleaning clothes, contact with other raw products, dirt, or hands of food handlers (PAHO and WHO, 2001).

Good Manufacturing Practices: Pre-requisites program proceeding, including the, hygienic and sanitary basis needed to implement an adequate HACCP system (PAHO and WHO, 2001).

HACCP: Hazard Analysis Critical Control Points is a system, which identifies, evaluates, and controls hazards, which are significant for food safety (Codex, 2003).

Microorganism: A form of life that can be seen only with a microscope: including bacteria, viruses, yeast, and single- celled animals (PAHO and WHO, 2001).

Pathogen: A microorganism (bacteria, parasites, viruses, or fungi) that is infectious and causes disease (PAHO and WHO, 2001).

Personal Hygiene: Individual cleanliness and habits (PAHO and WHO, 2001).

Food handler: Any person who directly handles packaged or unpackaged food, food equipment and utensils, or food contact surfaces and is therefore expected to comply with food hygiene requirements (codex, 2003).

Food safety: Assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use (2003).

Food: Any substance, whether processed, semi-processed or raw, which is intended for human consumption, and includes beverages, chewing gum and any substance which has been used in the manufacture, preparation or treatment of "food" but does not include cosmetics or tobacco or substances used only as drugs (PAHO and WHO, 2001).

Food- borne Outbreak: The occurrence of two or more people experiencing the same illness after eating the same food (PAHO and WHO, 2001).

Inspection: Is the examination of food or systems for control of food, raw materials, processing and distribution, including in process and finished product testing, in order to verify that they conform to requirements (codex, 2003).

Inspector: Means a properly trained officer appointed by the controlling authority of a country for the purpose of inspection of cake products and supervision of cake hygiene (codex, 1985).

Preventive measure: Any action or activity that can be used to prevent, eliminate or reduce a hazard to the health of consumer. Preventive measures refers to sources and factors that interfere with hazards such as the introduction, survival and/or multiplication of biological agents and introduction and permanence of chemical and physical agents (PAHO and WHO, 2001).

Chapter 1

Introduction

Food is ingested daily by everyone and it is essential for growth and continually of life. However, food may carry pathogenic microorganisms which can cause intestinal infections and intoxication. With the progress of sanitation and hygiene, food borne diseases are controlled but still there are many victims due to unhygienic practices and poor sanitation of food preparation. This imposed substantial health risk to consumers and severe economic burdens on individual communities and nation. It should be kept in mind that safety of the final food product is related to the safety of the initial ingredients involved in the preparation of the product.

Many ingredients could be the source of both spoilage and pathogenic microorganisms. Various spices generally have very high populations of mold and bacterial spores. Starch, sugar, and flour might have spores of thermophilic bacteria, yeast and mold. When sugars are used as ingredients in food products, the spores can survive and cause spoilage of products. Pathogens are not present in refined sugar unless contaminated (Krieg, 1984) and (Sneath, 1986). Pathogens have been also isolated from dried coconut, egg, and chocolate (Robert, 1990). The ingredients should be produced under sanitary conditions and given antimicrobial treatments. In addition, setting up acceptable microbial specifications for the ingredients will be important in reducing microorganisms in food from this source.

Human handling of food may be the source of pathogenic microorganisms in foods that later caused foodborne diseases, especially with ready to- eat foods. Improperly cleaned hands, lack of aesthetic sense and personal hygiene, and dirty clothes and hair can be the major sources of microbial contamination in foods. Poor personal hygiene is the third most commonly reported food preparation practice contributing to foodborne disease and further claimed that contaminated hands may be the most important means by which enteric viruses are transmitted (Lillquist, et al, 2005). The presence of minor cuts and infection in hands, face and mild generalized diseases can amplify the situation. In countries with the low hepatitis A endemicity, infected food handlers are the source of most reported food borne outbreaks (Tricco, et al, 2006). Then practices followed in cake product preparation handling, storage and raw ingredient used, intensify the extent of contamination.

Many types of microorganisms from air, raw foods, water, and personnel can get into the equipment and can multiply and act as a continuous source of contamination in the product produced subsequently. In some equipment, small parts, inaccessible sections, and certain materials might not be efficiently cleaned and sanitized. These dead spots can serve as sources of both pathogenic and spoilage microorganisms in food. Small equipment, such as cutting boards, knives, spoons, and similar articles, because of improper cleaning, can be sources of cross contamination.

Statistical data on food poisoning from developing and even developed countries are scarce and indicate that only a small number of individuals suffer food poisoning problem every year. Yet available data do not reflect the reality and present only the top of the ice berg. In case of salmonella it had been estimated that reported cases were only 1:29.5 of the real figure. In 1983 there were 381,881 fecal isolation of salmonella reported to CDC, if this number was multiplied by 29.5 then there would had been 1,146,989 escaping cases (Costanten, 1993). A growing incidence of food borne disease already affects between 5-10% of the population each year in industrialized countries (Food and Agricultural Organization / World Health Organization, FAO/WHO, 2005). Food is a potential vehicle for exposing consumers to different agents capable of causing disease or injury. At all stages of production, transport, storage, distribution and preparation for consumption, food can be contaminated with biological, chemical or physical agents. Hundreds of millions of people are affected by food-borne diseases each year and the problem is more widespread in developing countries (Slorach, et al, 2002).

Palestine is less developed in terms of food-borne disease surveillance and the data regarding this subject are few. Although the incidence rate of food poisoning that caused by microbial contaminated food was estimated at 27.1 per 100.000 in the year 2005 in Palestine (Ministry of Health (2005), data on microbial contamination of cake has not been.

1.1 General objective

The overall aim of the study is to assess food hygiene and safety among cake bakeries in Gaza Governorate.

The specific objectives are

1. To assess knowledge, attitude and hygiene practices of workers in cake production.
2. To evaluate cake hygiene and safety in relation to different plant locations and other variables.
3. To determine types of indicator organisms in final cake product.
4. To compare microbial contamination load with cake microbial acceptable limit.

1.2 Research questions

1- What is the level of workers' knowledge about cake microbial contamination?

2- How is the attitude of workers toward cake production?

3- What is the percentage of the workers who are applying personal hygiene and good hygiene practice?

4- What is the percentage of the cake bakeries plant who are applying elements of good manufacturing practice?

5- What are the main microorganisms in the final cake product?

6- Does the detected microorganisms compliance with the acceptable microbe limit?

1.3 Rational of the study

Ensuring safe and healthy food is essential for improving human life , whether developed or developing countries. Rather than being a luxury of the rich, all people should have the right to an adequate supply of safe and nutritious food.

Many diseases are transferred by food and some are fatal, (FAO/WHO, 2005) estimated that one in three people worldwide suffers from a food-borne disease every year, therefore most of these illnesses are due to microorganisms and chemical contaminants, which may be introduced at some point along the food chain.

Cake is considered as a perishable food with high risk of exposure to contamination where it contains (milk and eggs), in addition to weak and inadequate sanitation and water supply. Studying the microbial contamination of cake and the impact of bakeries and their practice on cake contamination in cake making plants in Gaza governorate is a pioneer study and has not been conducted before in the Gaza Strip. Therefore developing a solution based on scientific research findings, as well as putting forward recommendations that help in improving food hygiene and safety, in addition helps decision makers to establish Palestinian cake microbial limits and standards.

Chapter 2

Literature review

2.1 Overview

Cake is the product of mixing flour, milk, water, vegetable oil, eggs, cacao, flavor substances, and raising materials together to form dough, then baked in moderate temperature. After that cake is decorated with cream and may stuff with different materials such as canned fruit, chocolate, and honey. The cake is considered as perishable food because all the microbial factors which needed for growth were available in the final product.

There are several main sources of microbial contamination of a product including raw materials, equipment, production process, environment and people. The quality of raw materials can affect the overall quality of the finished product. Raw materials that are added to a product post-prepared (baked) such as cake cream and other materials for cake decorate may require more testing to verify compliance with a specification than one added before baked as considered the source of contamination in the final product and reach to consumers (Holah and Thorpe, 2002).

Food contact surfaces are particularly important potential sources of contamination, and sanitation (cleaning and disinfection) is the major day-to-day control. When undertaken correctly, sanitation programs have been shown to be easy to manage and, if diligently applied, can significantly reduce the risk of microbial contamination. Although a microbial surface may not be a source of contamination after sanitation, food residue on that surface during production can provide the opportunity for microbial growth, which could then be a source of recontamination to the product (Cordier, 2002).

The food production process and environment can be a source of general contamination; many surfaces not directly in contact with food may harbor microorganisms, e.g. non-food contact equipment surfaces, walls, floors, drains, overhead structures. These microorganisms can then be transferred to the food in the air via water droplets, dust and pest (insects and rodent). Presence and incidence of pathogens, their distribution in relation to processing lines and thus the risk of product contamination allow preventative measures to be established in the framework of Good Hygiene Practice (GHP) such as layout of processing lines and zoning within the factory.

Aerosol can be created from such areas and contamination can find its way into products on the manufacturing line. Air can contain microbial contamination from both external and internal sources, depending on the set-up of the factory. For example, microorganisms can enter the plant from outside. Internal contamination can occur from skin particles shed from factory personnel, dust particles from packaging materials, and aerosols created during either production or on-going cooling or cleaning processes (Fraser, 2002). Food production staff and food handlers are a potential source of contamination of food products. For this reason, it is important that adequate training is given, and that proper supervision ensures adherence to all hygiene measures, particularly hand washing.

2.2 Sources of cake contamination

2.2.1 Food handling and handlers:

(Dumavibhat, et al, 1989). revealed that the bacterial species demonstrated on hands and nails of food handlers or workers before and after hand washing were *Staphylococcus spp., Streptococcus spp., Micrococcus ssp., Bacillus spp., Diphtheriod, Aeromonas, Hydrophilia, Klebsiella pneumonia, A cinetobacter, Enterobacter cloacae, Escherichia coli, Pseudomonas spp, Proteus mirabilis, Serratia spp and Citrobacter freundii.* Before hand washing, each food handlers harbored one to eight bacterial species. After hand washing, disappearance of one to four bacterial strains from hands and nails were found in 47% of food handlers. However, there was recontamination with bacterial species in 17% food handlers.

Accident cake contamination by food handler with *Staphylococcus aureus (S. aureus)* that produced enterotoxin which was isolated from the nose, the fingernails, and a healed infection on the neck of the cake handler, and also from the cake was reported (Pereira, et al, 1994).

(World Health Organization (1996) reported that food handlers play an essential role in prevention of food borne disease. They may act as a source of food contamination, through inadequate personal hygiene or when handling food when they are medically unfit. They may also allow food to become contaminated and allow pathogenic microorganisms to survive and multiply to disease causing levels. Education of food handlers to adhere to good personal hygiene food handling practices is an essential component of a national food safety program.

(Mortimore and Wallace, 1998) stated that the source of *S. aureus* is frequently human in origin; from the skin, nose, throat, cuts and sores. Consequently it is easily transmitted to any food by handling and poor hygienic practices. If the bacterium is allowed to grow in food, it will produce a toxin that is stable to further heat processing and therefore cannot be made safe again.

(Sala, et al, 2005) described an outbreak of norovirus genogroup I gastroenteritis which affected hospital workers in Spain and was attributed to food prepared by an infected food handler. Forty cases were detected, of whom 80% were interviewed. The following symptoms were observed: abdominal pain in 90.6%, vomiting in 71.9%, diarrhea in 71.9%, general indisposition in 62.5%, headaches in 53.1% and fever in 32.4% of cases. The initial symptoms were abdominal pain in 37% and vomiting in 28%. Of the 14 samples, 12 (86%) were positive for norovirus genogroup I.

(Warren, et al, 2006) mentioned that *Shigella*, the causative agent of shigellosis or "bacillary dysentery", has been increasingly involved in foodborne outbreaks. *Shigella* was the third most reported foodborne bacterial pathogen in 2002. Foods are most commonly contaminated with *Shigella* by an infected food handler who practices poor personal hygiene.

The role of workers in foodborne outbreaks in 816 foodborne outbreaks and associated factors contributing to such outbreaks were discussed (Todd, et al, 2007). All the outbreaks had worker involvement of some kind, and the majority of food workers were infected. The most frequently reported factor associated with the involvement of the infected worker was bare hand contact with the food followed by failure to properly wash hands, inadequate cleaning of processing or preparation equipment or utensils, cross-contamination of ready-to-eat foods by contaminated raw ingredients, and (for bacterial pathogens) temperature abuse. (Esteves et al, 2007) confirmed the cross-contamination path between the raw material and casings and the role of handlers as an important cross-contamination vehicle.

(Salem, 1998) studied the prevalence and associated factors of communicable diseases especially parasitic infections among food handlers in King Fahd Hospital, Jeddah, Saudi Arabia. The study was conducted as a pre employment examination on 52 new kitchen male workers with a mean age of 26.77+/-5.03 years. They were subjected to complete medical examination as well as some general and specific laboratory investigations as a food handler. Results of throat swab showed that 12% of the studied group were positive for group A beta haemolytic *streptococci*. Parasitological examination showed that seven subjects (13.5%) were infected. Out of them 3 only had single parasitic infections and 4 had double infections. *Trichuris trichiura* was the most common infection in the studied group.

A suspected outbreak of *Salmonella* food poisoning at a retail premises was investigated (Duncanson, et al, 2003) six food samples and 24 environmental swabs were taken from the retail premises, and six food handlers' submitted faecal samples during the investigation of the outbreak. Results showed twelve of the 18 (67%) *Salmonella* culture positive samples. One food handler was found to be positive for *Salmonella.* All *Salmonella* isolates were confirmed as *Salmonella Enteritidis* phagetype 21c.

A survey for intestinal parasites was carried out with food handlers from two private and three public hospitals in Niterói City, RJ, Brazil (Lourenço, et al, 2004). Positive results were observed in 17.1%. The most frequent parasite was *Entamoeba coli,* detected in 48.5% of the samples with positive results. Under fingernail residues *E coli* were observed in 19.2% of the food handlers. *E. coli* cysts were found in one fingernail residue, likewise they were detected in the feces of the same food handler.

(Kimura, et al, 2005) pointed out that foodborne transmission is estimated to account for 95% of non-typhoidal *Salmonella* infections reported in the United States; however, outbreaks of *salmonellosis* are rarely traced to food handlers. In August 2000, an increase in *Salmonella* serotype Thompson infection was noted in Southern California; most of the cases reported eating at a restaurant chain. This outbreak is notable for implicating a food handler as the source of food contamination and for involving bread, a very unusual outbreak vehicle for *Salmonella*.

(Gauci and Gauci, 2005) mentioned that the majority of confirmed cases of food-borne illness in Malta are caused by *salmonellosis*. Detailed case investigations by the Disease

Surveillance Unit, Malta revealed that most of the notified cases of infectious intestinal disease are most likely to be due to poor food safety practices.

The majority of cases of foodborne gastroenteritis in the United States were reported to be caused by noroviruses (CDC, 2006). This report summarizes an investigation by the Kent County Health Department in Michigan into three norovirus outbreaks and a cluster of community cases during May, 2005. The investigation identified a potential source; a food handler who had returned to work within a few hours of having symptoms of gastrointestinal illness while he was still excreting norovirus in his stools.

2.2.2 Ingredients as a source of contamination:

Low level of *Listeria monocytogenes* were reported to be present in 5% of samples of commercially broken raw liquid egg (leasor and Foegeding, 1989). Regarding flower, (Hobbs and Roberts, 1993) reported that the various flours contain spores, particularly those of regard dry flour, *Bacillus* cereus and also those of anaerobes such as *Clostridium perfringens*, so that there is the possibility of support out growth in rehydrated mixes. For example *bacillus* cereus has been isolated in large numbers from baked cakes of moist consistency in the center and sold warped in cellophane. Even *Clostridium perfringens* and *staph. aureus* have been isolated from a cake stored in the refrigerator and eaten from time to time.

A study was carried out to obtain information on the decline and potential survival of *E. coli*, particularly verocytotoxin-producing strains, in reduced water activity confectionery products chocolate, biscuit cream and mallow (Baylis, et al, 2004). These products were artificially contaminated with high (4 log10 cfu/g) and low (2 log10 cfu/g) levels of *E. coli O157:H7, O111:H-* and *O26:H11* and their survival, as affected by storage temperature (10, 22 and 38 °C), was monitored over 12 months. Rapid decline was observed in products stored at 38 °C and increased survival occurred in products stored at 10 °C. In chocolate (average water activity 0.40), these bacteria were detected for up to 43 days in samples stored at 38 °C. At 22 °C they survived for up to 90 days and in product stored at 10 °C they could still be detected after 366 days storage. In biscuit cream (average aw 0.75) they survived for 2 days at 38 °C, 42 days at 22 °C and 58 days at 10 °C. Whilst mallow (water activity ca. 0.73) was not stored at 38 °C, these bacteria could still be detected in samples stored for up to 113 and 273 days at 22 and 10 °C, respectively.

(Moon, et al, 2007) investigated the prevalence of *S. aureus* in samples of bovine mastitic milk (n=714), raw meat (n=39), and vegetables (n=616). The degrees of relatedness of isolates as indicated by *antibiogram, staphylococcal enterotoxin* (SE) productivity, and coagulase gene restriction fragment length polymorphism analysis were determined. Also, they examined 297 *S. aureus* isolates and found SE production in 57 (31.8%), 4 (7.8%), and 49 (73.1%) isolates from raw milk, raw meat, and vegetables, respectively. A high proportion of the isolates obtained from milk produced more than two types of toxins (mainly SEA, SEB, and/or SEC), whereas isolates from raw meat and vegetables primarily produced SEA alone. Most isolates were sensitive to *cephalothin* (97.6%), *gentamicin* (80.8%), *erythromycin* (79.5%), and *tetracycline* (72.7%), but were resistant to *penicillin* (90.2%) and *ampicillin* (88.9%). The proportion of antibiotic-resistant isolates differed according the source of the bacteria; the milk and vegetable isolates were more resistant to *penicillin* and *ampicillin* than were the meat isolates ($P < 0.05$), whereas tetracycline resistance was limited to the milk and vegetables isolates. The coagulase genotypes (I to XII) varied with the source of the organism, and only a few genotypes prevailed in each source: II (42.4%) and IV (24%) types in isolates from milk, IX (35.3%) and XI (45%) from raw meat, and III (40.3%) and XII (32.8%) from vegetables.

(Nieminen, et al, 2007) screened 100 milk samples of mastitic cows from different parts of Finland to elucidate the occurrence of heat-stable toxin-producing strains among *mastitic Bacillus* isolates. *Bacillus* was identified as the major organism in 23 samples. The toxic substances were heat-stable and soluble to methanol thus being of non-protein nature. The ribopatterns of the mastitic *B. pumilus* and *B. licheniformis* isolates were similar to those of the toxinogenic strains food poisoning incidents and contaminated indoor air. *B. licheniformis* and *B. pumilus* survive pasteurization and other heat treatments as spores. Toxin-producing strains of these species in the dairy production chain may thus be of food safety concern.

(Stephens, et al, 2007) described one of the largest egg-associated outbreaks of foodborne illness in Australia for many years. Between June and December 2005, five outbreaks of *Salmonella Typhimurium* phage type 135 were identified in Tasmania, leading to 125 laboratory-confirmed cases. Public health investigations included case and food handler interviews, cohort studies, environmental health investigations of food businesses, microbiological testing, traceback, and inspections and drag swabbing of an egg farm. These investigations enabled identification of foods containing raw egg or foods contaminated through inadequate food handling and/or storage procedures as possible vehicles for infection.

2.3 Contaminant cake samples

(Fustier, et al, 1998) illustrated that molds were isolated from commercial cakes and were identified as *Aspergillus sydowii, Aspergillus ochraceus, Penicillium funiculosum, and Eurotium herbariorum.*

A total of 1,096 cases recovered from 40 organizations located in 30 prefectures, (Japan) were analyzed (Sakai, et al, 2004). Most foods with fungal contamination were "cake and snacks", "beverages" and "bakery products", and processed and cooked foods and beverages accounted for more than 90% of the complaints. The numbers of cases were greater in the summer and less in the winter. The major fungal genus detected in the suspect foods were *Penicillium, Aspergillus* and *Cladosporium. Aspergillus niger* was the dominant species contaminating bakery products.

(Zhang, et al, 2007) indicated that during May and June of 2005, 26 persons in several US states were infected by a single strain (isolates indistinguishable by pulsed-field gel electrophoresis) of *Salmonella enterica serotype Typhimurium* after eating cake batter ice cream. The cake mixer used to prepare the cake batter in the ice cream was implicated by epidemiologic investigation as the source of *Salmonella* contamination.

2.4 Factors affecting microbial growth in cake

2.4.1 Temperature:

Pathogenic bacteria grow best in the temperature range between 4°C and 60°C. Temperatures below 4°C will not kill pathogenic bacteria but will not allow them to multiply enough times to cause an illness. Temperatures above 74°C will kill most pathogenic bacteria. This is the easiest factor in controlling pathogenic bacterial growth.

2.4.2 Food composition:

Pathogenic bacteria grow best when there is a rich food supply. Pathogenic bacteria and spoilage bacteria grow most quickly in high protein food such as milk and egg. It is difficult to control pathogenic bacterial growth in high protein food.

2.4.3 Available Water:

Pathogenic bacteria need a water supply to survive. Lower water will not kill pathogenic bacteria but it will not allow them to grow.

2.4.4 pH:

pH is the measure of the level of acid and can range from 0 to 14. Pathogenic bacteria need a neutral environment to survive. High or low pH will not kill pathogenic bacteria but will not allow them to grow.

2.4.5 Gas presence:

Some pathogenic bacteria can only grow where there is oxygen (aerobic bacteria) while other pathogenic bacteria can only grow where there is no oxygen (anaerobic bacteria). It should be aware of those bacteria that grow without oxygen.

2.4.6 Time:

Leaving food out at room temperature for more than 2 hours might be long enough for the pathogens to multiply enough to cause a foodborne illness.

The previous six factors together will allow pathogenic bacteria to multiply enough times to cause a food poisoning. By sufficiently changing or eliminating one of the criteria, bacterial growth can be prevented or delayed.

(Escartín, et al, 1998) showed that when mocha cake was stored at 30°C, *S. aureus* increased in number by more than 4 log after 48 h. However, *S. aureus* did not grow in the cake stored at 4-7 °C.

(Fustier, et al, 1998) studied the effect of relative humidity on the growth of the *mold* inoculated with *mold* spores and incubated under three equilibrium relative humidity levels: 97, 85, and 75%. They found that growth of *molds* was much slower in the samples incubated in 75% relative humidity.

(Abellana, et al, 2001) studied the effect of temperature and water activity and their interactions on the rate of mycelia growth of *Penicillium aurantiogriseum, P. chrysogenum, P. corylophilum* and *Aspergillus flavus* on a sponge cake analogue. Growth rates showed dependence on water activity and temperature. However, no significant differences were observed in the growth rates of different isolates. The minimum water activity values for growth of the *Penicillium spp.* was 0.85-0.90. A. flavus was able to grow at 0.90 water activity when the temperature was above 15 degrees C. This study has shown that fungal growth by these species on a sponge cake analogue, with a composition similar to usual bakery products, is prevented if the water activity is kept at < 0.85.

(Suhr and Nielsen, 2004) investigated the effect of inhibition of spoilage organisms from bakery products by weak acid preservatives in concentrations of 0%, 0.003%, 0.03% and 0.3% at different water activities water activity and pH values. Initially, rye bread conditions water activity (0.94-0.97 and pH 4.4-4.8) in combination with calcium propionate. Results showed that the highest concentration of propionate (0.3%) at all conditions apart from high water activity (0.97) and high pH (4.8) totally inhibited fungal growth for a 2-week period, with the exception of *Penicillium roqueforti, Penicillium commune* and *Eurotium rubrum.* Also, higher water activity levels as well as higher pH values decreased spoilage-free times of the fungi.

2.5 Food poisoning from cake ingestion

(Murao, 1991) reported an outbreak of gastroenteritis in December, 1989 associated with cake consumption occurred in a day-care center with 60 children and 12 staff in Saitama prefecture, Japan. Children were served cakes at the Christmas party and ate them with their families. Thirty-three of the 59 children (56%), 16 of the 74 families (22%) and 1 of the 10 staff (10%) eating the cakes became ill. Illness consisted primarily of nausea, vomiting, diarrhea and fever; the median incubation period was 31 hours. Bacteriological analysis of stool specimens did not reveal a causative agent. Small round structured viruses were detected in fecal specimens from 10 of the 17 ill children (59%) and 2 of the 6 ill families (33%) by electron microscopy.

Two persons were found to be affected after consuming the cake, with symptoms of *staphylococcus* enterotoxin food poisoning in one person and *Clostridium perfringens* food poisoning in the other (Hobbs and Roberts, 1993). Many outbreaks of paratyphoid fever and *salmonella* food poisoning were then traced to imitation cream cakes and other confectionary prepared in bakeries using contaminated egg products.

(Pereira, et al, 1994) pointed out that twelve people became ill with vomiting and diarrhea approximately four hours after eating cake with a cream filling at a birthday party and on the day following. *S. aureus* that produced enterotoxin was detected in the remaining portion of the cake.

(Evans, et al, 1996) mentioned that outbreak of *Salmonella enteritidis* phage type 4 (PT4) traced to the bakery occurred in Cardiff, Wales, United Kingdom during August-September 1992. In the outbreak, illness was associated with eating fresh cream cakes (odds ratio 15.8, 95% confidence interval 1.6-374, P=0.004). Environmental investigations implicated cross-contamination during preparation and inadequate cleaning and disinfection of nozzles used for piping cream. *Staphyloccocus enteritidis* PT4 was isolated from fresh cream sponge cake retained by a case and from two fresh cream cakes and four environmental swabs obtained at the bakery. This incident illustrates the hazard of widespread environmental contamination with *salmonella* and the need for thorough environmental cleansing for any premises implicated in an outbreak of food poisoning.

(Escartín, et al, 1998) described a foodborne outbreak due to *S. aureus* enterotoxin associated with the consumption of mocha cake in the city of Guadalajara, Spain. The cake was prepared in a bakery and affected nearly 100 persons. A *S. aureus* strain was isolated from the cake involved in the outbreak.

(Serra Bonvehí, 2004) studied ochratoxin A (OTA) in 170 samples of cocoa products of different geographical origins in cocoa bean, cocoa cake, cocoa mass, cocoa nib, cocoa powder, cocoa shell, cocoa butter, chocolate, and chocolate cream. The highest levels of OTA were detected in roasted cocoa shell and cocoa cake (0.1-23.1 μg/kg) and only at minor levels in the other cocoa products. Twenty-six cocoa and chocolate samples were free from detectable OTA (<0.10 μg/kg). In roasted cocoa powder 38.7% of the samples analyzed contained OTA at levels ranging from 0.1 to 2 μg/kg, and 54.8% was contaminated at >2 μg/kg (and 12 samples at >3 μg/kg). (OTA) was detected in cocoa bean at levels from 0.1 to 3.5 μg/kg, the mean concentration being 0.45 μg/kg; only one sample exceeded 2 μg/kg (4.7%). In contrast, 51.2% of cocoa cake samples contained OTA at levels ≥2 μg/kg, among which 16 exceeded 5 mg/kg (range of 5-9 μg/kg).

The source of a norovirus outbreak among attendees of 46 weddings taking place during a single weekend was determined. Norovirus-compatible illness was experienced by 332 (39%) of wedding guests surveyed; the outbreak affected up to 2700 persons. Illness was associated with eating wedding cake provided by a bakery common to the weddings (adjusted RR 4.5, P<0.001). A cake requiring direct hand contact during its preparation accounted for the majority of illness. At least two bakery employees experienced norovirus-compatible illness during the week preceding the weddings. Identical sequence types of norovirus were detected in stool specimens submitted by two wedding guests, a wedding hall employee, and one of the ill bakery employees. It is likely that one or more food workers at the bakery contaminated the wedding cakes through direct and indirect contact. These findings reinforce the necessity of proper food-handling practices and of policies that discourage food handlers from working while ill (Friedman, et al, 2005).

(Prato, et al, 2006) reported an outbreak of hepatitis A in the city of Bari, Italy in June 2002. Overall, 26 cases were observed over a 4-week period. These cases were traced back to the index case, a food handler who prepared various food products for sale over the counter at a store in the district (OR 5.36, CI 95% 1.58-19.25). Laboratory investigations confirmed that the outbreak was due to a point source.

2.6 Worker knowledge, practice and training:

In March 1999, an outbreak of gastroenteritis Norwalk-like virus was found in five cases and in one ill and one asymptomatic food-handler (Götz, et al, 2002). Contamination by one of the food-handlers seems the most likely route of spread of the virus and underlines the importance of strict hygienic practice routines.

(Levy, et al, 2003) reported an outbreak due to *Streptococcus pyogenes* occurred among inmates of a rural correctional center in New South Wales, Australia. A total of 72 (28%) of 256 inmates became ill in December 1999. *Streptococcus pyogenes* type M-75, T-25, which was opacity factor positive, was isolated from throat swab specimens obtained from 5 of 57 inmates with primary cases and from 4 of 15 inmates with secondary cases, as well as from specimens obtained from the hand wounds and throat of one of the food handlers. The presumed source of the food contamination was the food handler who had infected hand wounds.

The outbreak of Norovirus was investigated by American - Centre for Diseases Control and Prevention (CDC) as mentioned by (Dippold, et al, 2003). Three stool specimens collected from ill attendees contained norovirus. The epidemiologic did not identify a specific vehicle of transmission. The environmental investigation revealed food-handling practices and food handler perceptions, that may have contributed to disease transmission.

(Henroid and Sneed, 2004) evaluated current food-handling practices, food safety prerequisite programs, and employee knowledge and food safety attitudes and provide baseline data for implementing Hazard Analysis and Critical Control Point (HACCP) systems in school foodservice. One member of the research team visited each school to observe food-handling practices and assess prerequisite programs using a structured observation form. A questionnaire was used to determine employees' attitudes, knowledge, and demographic information. Result showed that Proper food-handling practices were not being followed in many schools and prerequisite food safety programs for8 HACCP were found to be inadequate for many school foodservice operations. School foodservice employees were found to have a significant amount of food safety knowledge (15.9±2.4 out of 20 possible points). Employees who had a food handler certificate were found to have higher food safety practice scores.

The effectiveness of traditional (lecture/video) training was compared with that of traditional training that provided an added active (hands-on) component for the retention of hand washing procedures two weeks after the initial training (TLillquist, et al, 2005). Sixty-six food handlers attending training courses were included in the study. All participants received the same lecture/video presentation. Twenty-two (33%) of the participants received an additional interactive training component. All participants were tested by a 20-item written test on the day of training. Two weeks after the training, (25% to 30%) percent of participants from each group were retested. Results revealed that the participants involved in the interactive training had statistically significant better test performances both on the day of training and on the two-week retest.

Food handler focus groups in two Oregon counties, USA discussed knowledge, practices, and barriers related to handwashing in the restaurant environment (Pragle, et al, 2007). Important barriers were time pressure, inadequate facilities and supplies, lack of accountability, lack of involvement of managers and coworkers, and organizations that were not supportive of handwashing. The authors recommend that future educational and training programs include 1) a hands-on training program that orients new employees to correct handwashing practice and more advanced education about foodborne illness; 2) involvement of both managers and coworkers in the training; 3) easily accessible hand-washing facilities stocked with necessary supplies; 4) continued handwashing training and support involving the food service industry, managers, and coworkers; and 5) involvement of health departments and inspectors in providing managers and food workers with advice and consultation on improvement of handwashing practice

(Christin, 2007) reported that persistence of foodborne diseases depends largely upon poor compliance with the rules of proper food hygiene, especially with storage and preparation of food items. While these processes are subjected to strict controls when food items are industrially processed. Altogether these factors compromise food safety. A good knowledge of foodborne diseases, whether native or imported is thus relevant to today's general practice.

(Van Tonder, et al, 2007) presented data on personal- and general-hygiene knowledge and practices among food handlers in the delicatessens of a major retail group in the Western Cape in South Africa. Food handlers were interviewed by means of a structured questionnaire. Although the majority of food handlers adhered to basic hygiene principles, there is definitely a need for proper and continuous training in personal and general hygiene, not only for food handlers, but also for management.

Chapter3

Conceptual framework

Thesis conceptual framework is illustrated in Figure 3.5

3.1 Process line

Food is necessary for maintaining people life, however, it may be the cause of illness when it is contaminated during the production process. The source of microbial contamination of raw materials of plant origin is from the field (ground, air dust, and fertilizing), handling, collection, storage, and distribution. On the other hand, raw material produced from animal origin such as egg is contaminated from digestive track of the chicken and also from handling, collection, storage and distribution. The microbial load during the process of food production in some stages decreased when the product for example treated with heating, in other cases increased when mishandling occurred.

Food hygiene is defined as conditions and practices that preserve the quality of food to prevent contamination and foodborne illnesses (Hand book of food hygiene, 2005). or it is defined as all conditions and measures necessary to ensure the safety and suitability of food at all stages of the food chain (CAC/RCP, 2003).

Experts described food safety problems in terms of hazards, with those hazards categorized as chemical, microbiological, or physical. They have long considered the most dangerous hazards to be those of microbiological origin, followed by those of naturally occurring toxins (Wodicka 1977; Cliver 1999). However, pesticides and additives have been prominent subjects for the media, which may lead some people to focus on those hazards more than others. But as more stories emerge of people becoming ill from bacterial contamination, the public is increasingly aware of the importance of microbiological hazards. People do die from microbial hazards, but deaths due to consuming pesticide residues or food additives are rare (Hand book of food hygiene, 2005). A major focus of this thesis is on the microbial contaminants mainly the microbial contaminant indicators. Ensuring the safety of food is a shared responsibility among producers, industry, government, and consumers.

3.2 Operational definitions

Samples from the final product will be tested for microbial contaminants. However, with so many different *bacteria* and *molds* that can contaminate cake, it is not possible to test the cake for each of these separately. Instead, indicator organisms are used which they are easily detected and it is considered as indicators for the cake contamination. Indicator organisms are groups of microorganisms that are indicative for the possible of pathogens. It can also be assumed that reduction in the numbers of the indicator organisms will produce a similar reduction in the numbers of any corresponding pathogen (Brown, et al, 2000). These indicators include Total Bacteria Count (T.B.C), *S. Aureus, Coliform, E.coli, Salmonella, Mold, Yeast* and *Oidium Lactis (O. lacts).* The final product is considered out compliance when the count of any one of the mentioned microbes exceeds the microbial limit for cake.

3.3 Factors affecting the presence of microbial load in the cake

The final product of cake as mentioned above may be contaminated with microbes during the process in some stage, affecting by handling "GHP" and the measures of applying Good Manufacturing Practice (GMP) in the plant. Other factors may decrease the load of microbes according to the treatment process. These factors include:

3.3.1 Ingredients:

Primary ingredients in cake composition play an important role in the quality of the final product. For years scientists believed that the inside of an egg was sterile and that *Salmonella enteritidis* was not of concern. however, in 1989, they discovered that chickens infected with *Salmonella* and pass this infection along in their eggs, so that the *bacteria* can be inside the raw egg, making it unsafe to eat raw or undercooked eggs. Knowledge of this fact caused food safety experts to advise people to cook eggs thoroughly or to use liquid pasteurized eggs. This means, cream, cookie dough, that contain raw eggs could be infected with the bacteria. Cooking of the cake in the oven at moderate to high temperature is enough to kill most of microbial load in ingredients that composite the dough. However, ingredients that were not treated with heat, which composite the stuff materials and cream containing raw eggs used for cake decoration in final product, is considered to be a good media for microbial growth which may cause food poisoning.

3.3.2 Tools and equipments:

Hygienic design of food production facilities, processing equipment and product contact surfaces should be smooth easy to clean and disinfectant to prevent recontamination. Therefore, they should be free of crevices, pitting, pinholes and any hairline cracking that can cause material penetration and cleaning difficulties. Poorly designed plants and equipments can easily resulted in contamination of food products and lead to food poisoning incidents. Furthermore, design deficiencies may result in losses of product due to spoilage, increased cleaning costs and reduced production time. Effective cleaning of premises and equipments must be carried out frequently using the methods and materials specified in well- designed cleaning schedules and instructions.

3.3.3 Place and environment:

Cake making plant should be located, constructed and maintained according to sanitary-design principles. There should be linear product flow and traffic control to minimize cross-contamination from raw to cooked materials and from dirty to clean areas. Buildings, fixtures and other physical facilities of the plant should be maintained in sanitary condition and in a satisfactory state of repair. Cleaning and sanitizing of utensils and equipment should be conducted in a manner that protects against contamination of food, food-contact surfaces, or food-packaging materials.

Potential sources of contamination from the environment should be considered. The buildings in which food is processed or stored should not be located in close proximity to sites that are sources of environmental pollutants, pest infestations, smoke or dust, to areas that accumulate wastes or stagnant water, or have industrial, agricultural or other activities which are potential sources of food contamination. If any of these undesirable conditions exist, there should be adequate safeguard to protect against any potential contamination or pest infestation. Now a days there is a great attention for choosing the site of plant place, in regard to be far from external environment pollutant which may be polluted the plant and effected the final product. The speed and direction of the air flow in the production area are important as they can move contamination around a factory. Choosing suitable place and good design can prevent internal and external pollutants.

3.3.4 Handling and storage:

Safe handling for raw materials, intermediate and final product lead to eliminate cross contamination, whereas the primary ingredients, if not dealing correctly, it will increase microbial load. Incorrect handling with intermediate after cooking the dough will contaminate the product. During cake decoration incorrect handling will provide a good chance for microbial contamination; microbes will grow and rapidly multiplying leading to spoil the product and indicating the existence of pathogens that cause food poisoning. Materials and products should be stored under conditions specified in their respective specifications and effective protection of raw materials and products from contamination and cross-contamination. Storing the final product at refrigerator at low temperature bellow 4ºC is very important to retard the spoilage isolated from raw materials specially eggs, and to prevent cross contamination. Related packaging material also consider as critical, because any contamination will find in the product. Finally Products that have been recalled or returned should be marked and physically segregated, preferably in an entirely separate storage facility.

3.3.5 Personal hygiene:

Personal hygiene refers to the cleanliness of a person’s body. The workers health plays an important part in food sanitation. People are potential sources of microorganisms that cause illness for others through the transmission of viruses or through food poisoning. Human illnesses that may be transmitted through food are diseases of the respiratory tract such as common cold, sore throat, pneumonia, scarlet fever, tuberculosis and trench mouth; intestinal disorders; dysentery, typhoid fever, and infectious hepatitis. In many illnesses, the disease-causing microorganisms may remain with in the person after recovery. A person with this condition is known as a carrier. In addition, other sources of food contamination may include hair, skin, mucous membranes, digestive tract, wounds, infections and clothing. Handlers can transfer pathogens of all kinds to food. However, this can be avoided through adequate personal hygiene, improved behavior and handling.

3.3.6 Personal practice:

Producers should know hygiene practices in order to control and assure minimal sanitary quality and guarantee cake safety. It is very important that workers applying their knowledge about microbes and their main sources, the role of spoilage organisms and pathogens that are significant in food contamination, personal cleanness, plant and equipment cleaning and disinfectant, waste disposal and pest control in cake processing practice to achieve safe cake product. One of the first safety systems developed by the food industry was that involving the application of GMP, as a supplement to end- product testing. GMP covers all aspects of production from starting materials, premises and equipment to the training of staff. GMP also provide a framework for hygienic food production, which is often referred to as GHP.

3.3.7 Personal behavior:

People engaged in food processing should avoid any behavior that could result in food contamination. Smoking, spitting, chewing or eating, sneezing or coughing is unacceptable because it increases the probability of food contamination. Personal properties such as jewelry, watches, pins or other such items should not be worn or brought into food handling areas if they pose a threat to the safety and suitability of food. These objects should be kept in the dressing room. Glasses and ear protectors, when used, should be fastened by a string around the neck to prevent them from falling into the food product.

3.3.8 Personal training:

Those engaged in food operations either directly or indirectly into contact with food should be trained on food hygiene at a appropriate leveling in regard to the operations they perform. Food hygiene training is fundamentally important. All personnel should be aware of their role and responsibility in protecting food from contamination of foodborne pathogens or microorganisms that cause deterioration. Food handlers should have the necessary knowledge and skills to enable them to handle food hygienically. Those who handle cleaning chemicals or other potentially hazardous chemical should know safe handling techniques. Everyone integrated in food production from primary production to final product should be trained on GMP and his / their responsibilities. The primary purpose of training is to improve job performance. Training for new employees means that each newcomer will learn the specifics of the job he or she is expected to do, as well as the performance criteria associated with the job. Training for long-term employees provide each of them with an opportunity to maintain or improve the skills required in a specific job. In general training is considered a positive factor in achieving organizational and personal goals, and employees learn early in their careers to look forward to the training that will increase their skills inventories and enhance their ability to contribute to the organization.

3.4 Laws and regulations

Imposing and enacting food regulations and legislation according to Palestinian health law and other Palestinian laws interested in food hygiene and safety, in addition adopting international food safety in relation with the international standards such as Codex Alimentarius commission, food standards and GMP, would ensure the safety of the end product. GMP covers all aspects of production, from starting materials, premises and equipment to the training of staff. GMP also provides a framework for hygienic food production, which is often referred to as GHP. GMP meets the requirements of both government as well as customer.

Intervention policy related to official interventions to control diseases and improve environmental safety include obligatory medical examinations of all persons working in food plants and sales store leading to produce wholesome food . It also related to personnel follow up whom are positive for medical examination and preventing them from handling food items till they recover. This in particular, applies by preventive medicine department in Ministry of Health (MOH). Intervention policy also includes imposing and application of good hygienic and good environmental conditions, official licensing of food handling places and monitoring microbial analysis for food stuff. These action should be carried out by all various official parties taking role in food safety namely MOH, Ministry of National Economy (MONE) and Gaza municipality in a cooperative and coordinated manner. When plant owners in regard to hygienic conditions they would adopt personal hygiene and good hygiene practices, which include:

1- Availability of personnel hygiene facilities.

2- Wearing special clothes for work and keeps it clean.

3- Exclude food handlers in case of illness and injuries especially diarrhea.

4- Prevent cross contamination during the process of cake making.

5- Keeping final cake product out of the dangerous zoon temperature that is more than 5ºC.

6- Good knowledge of pest control and preventing its presence in places of food processing and preparation.

7- Good knowledge and practice of adequate cleaning and sanitation of instruments and work place.

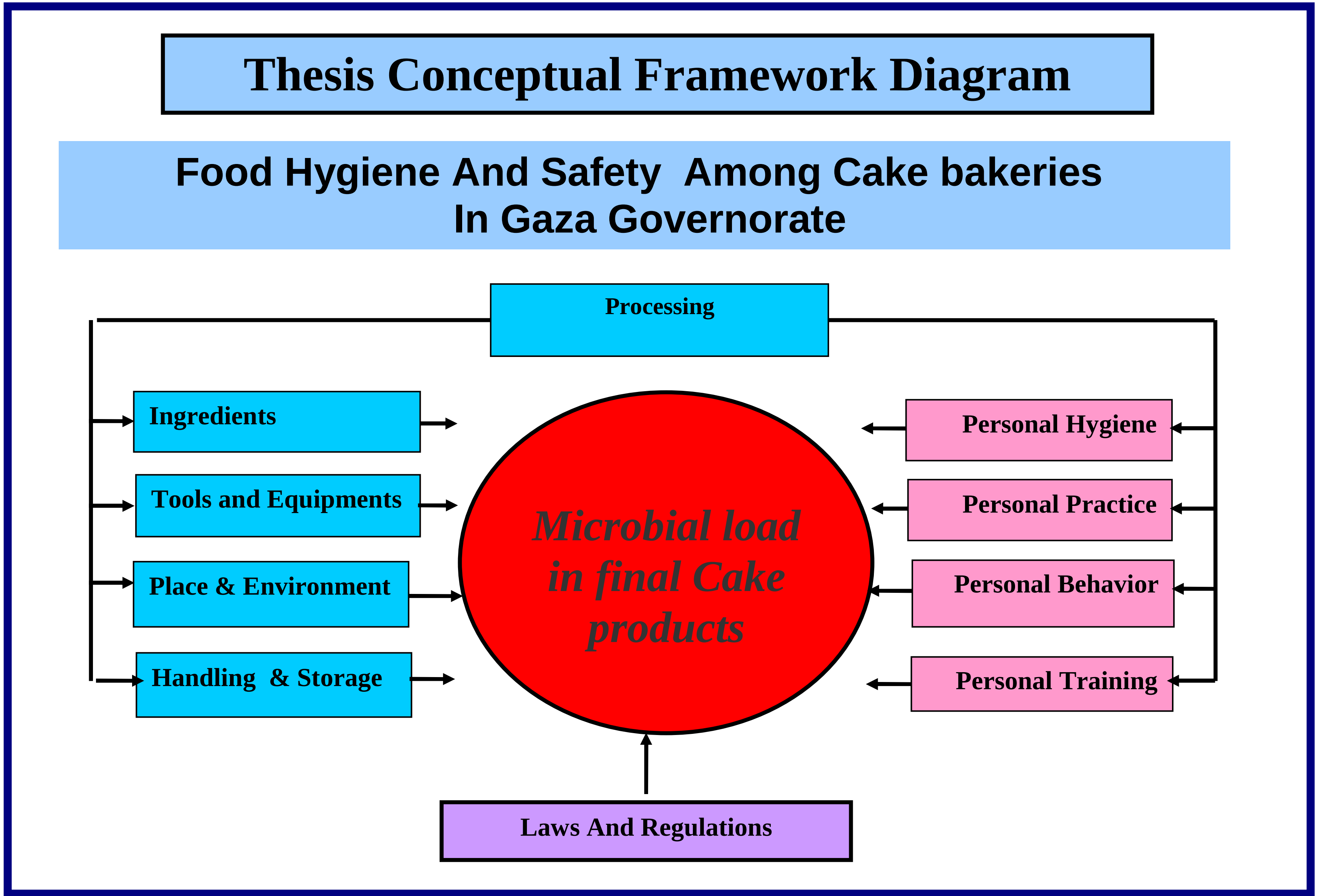
Thesis Conceptual Framework Diagram
Food Hygiene And Safety Among Cake bakeries
In Gaza Governorate
Processing
Ingredients
Tools and Equipments
Place & Environment
Handling & Storage
Microbial load in final Cake products
Personal Hygiene
Personal Practice
Personal Behavior
Personal Training
Laws And Regulations

Figure 3.5

Chapter 4

Methodology

4.1 Study Design

A cross sectional study was used to assess food hygiene and safety among cake bakeries in Gaza Governorate. This method would be useful for descriptive analysis of study variables. Also, it enables the researcher to meet the study objectives and to examine the association between the variables.

4.2 Target population

The target population of this study was 90 cake bakeries from all cake making plant in Gaza Governorate according to Gaza municipality were 34 cake making plants which are 23 of 34 licensed and 11 of 34 unlicensed cake masking plants in Gaza Governorate.

4.3 Setting of the study

The present study was carried out on cake making plants in various suburbs of Gaza Governorate in which most plants of the Gaza Strip are located. Therefore, Gaza Governorate is considered to be representative for the Gaza Strip.

4.4 Data collection period

Data were collected during six months period from January to June 2008.

4.5 Cake sample size and sampling

One hundred and seventy three cake samples were collected from cake plants in Gaza Governorate; 124 samples from licensed and 49 samples from unlicensed plants. In every visit the researcher took a sample (5 pieces of cake) from each cake making plant from refrigerator temperature at 5ºC. The samples were immediately transported in plastic ice box to the laboratory in retail packages and then were processed on the day of acquisition. All samples were analyzed within their assigned shelf lives.

4.6 Eligibility criteria

1. Inclusion criteria: Cake making plants whether they were licensed or unlicensed by Municipality of Gaza City, Gaza Governorate.
2. Exclusion: imported ready made cake.

4.7 Ethical considerations

Ethical considerations have been taken into account:

1. Approval of Helsinki committee in the Gaza Strip (annex 1).
2. An agreement for using the laboratory of the Ministry of Health (annex 2).
3. Consent form has signed by all persons included in the study (annex 3) which include the followings:

a) Participants have the right to voluntarily participate.

b) Participants are previously informed about the study's objectives and data collected from them will be confidential and only for the purpose of the study.

c) Participants have the right to withdraw from the study whenever they decide.

d) Society's values, norms and cultures are respected during the whole study.

4.8 Tools of the study

Three instruments were used for data collection:

1. A structured interview questionnaire (annex 4).
2. Official methods of microbial analysis (Food and Drug Administration, Bacteriological Analytical Manual, 1995) in cake samples for TBC, *Coliform, E.coli, S. Aureus, Salmonella, Yeast and Mold* and, *O. lacts* were carried out in Food and Water Laboratory in Sabha Clinic, MOH, Gaza Governorate. Laboratory results were registered in special form (annex 5) before entering in the computer.

4.9 Questionnaire interview

A meeting interview was conducted to fill the questionnaire. The questionnaire was deigned according to the recommended code of good manufacturing practice (codex alimentareus, 2003). Most questions were one of two types: the yes/no question, which offers a dichotomous choice; and the multiple choice question, which offers several fixed alternatives (Backestrom and Hursh-Cesar, 1981).

4.9.1 Validity of the questionnaire:

The validation of the questionnaire was done by ten different experts including researchers, managers, and specialize persons(food safety specialist, food control, PH.D in civil engineering, and Environment). The response rate of the experts was 70%. Their comments and notes were taken into consideration when writing the final questionnaire.

4.9.2 Construction of the questionnaire:

A structured face to face questionnaire interview was conducted by the author himself The questionnaire included questions related to:

A. Personal data of cake workers: Age, gender, address, education, experience, position.

B. Personnel Hygiene of workers: Health status, personal cleanliness and personnel behavior.

C. Workers' knowledge: Knowledge of cake workers on microbes, their sources, growth and food safety

D. Practice of cake workers: Cake workers Practice related to ingredients, Pest control, cleaning and disinfecting of tools and equipments, solid waste container and wastewater and product process and preservation.

E. Cake workers' attitude: suitability of plant area, experience, motivation, applying GHP.

F. Cake plant facilities and general health condition: Address, name of the plant, number of workers, license, inspection, area, floor, ventilation, lightening, water source.

4.10 Pilot study

A pilot study was conducted before starting the actual data collection process as a pre-test for data collection instrument in order to test the suitability of the instrument and to detect the need for any modifications to be done to the instrument. The questionnaire was piloted with 10 bakeries included in the sample from the study, and modified as necessary. Ten cake samples were collected and analyzed for microbial contaminants in Food and Water Laboratory in Sabha Clinic, MOH, Gaza Governorate**.** The samples were included in the study**.**

4.11 Microbial analysis

The bacteriological media that used in this study were prepared according to Difco (1985) and Oxoid (1995) manuals. The procedures followed for the detection of different bacteriological parameters was as described in the Standard Methods (FAD, 1995).

4.12 Equipments and Instruments

- Blender and blender jar (WARING COMMERCIAL; Model No.35BL59)
- Stomacher (AES Laboratoire CE 35270; France)
- Knives
- Incubator
- Balance with capacity of 2 kg and sensitivity of 0.1 g (METTLER TOLEDO; AB104-S)
- Sterile utensils for sample handling
- Quebec colony counter, with magnifying lens (ANDERMAN COUNT**)**
- Longwave UV light (D & RI ; Dinco & Rhcnium Industries)
- pH meter (TOA Electronics Ltd.)
- Sterile cups
- Syringes (1 ml and 10 ml)
- Glassware
- Ice box
- Analytical profile index (API) 20E strips and API Staph (Bio Merieux).

4.13 Compliance of microbial results

According to Gulf Countries Standard of microbiological limits for goods and food stuffs 47/49/98, to the final cake products. The microbiological demands as follow if the sample was taken from the market, or cake making plant the maximum limits of T.B.C*, S. aureus, Coliform, E.coli, Salmonella***.** 10E5, 10E2, 10E3, 0 and negative cells/25g respectively. Hence, the increase of these counts mentioned above defined as non complied or not accepted results in this thesis.

4.14 Sample preparation for microbial analysis

Each cake samples was mixed in a blender with saline to prepare a dilution, all counts as colony forming units per gram cake (CFU/g).

4.15 Microbiological determination

Cake samples were examined for total microbial count and count of some microbial groups, each group in relation to its specific medium and determination technique.

4.15.1 Total bacterial count:

Decimal dilutions (10^{-2}, 10^{-3}, to 10^{-4}) of cake samples (prepared as described in preparation of the sample) were used. One ml of each dilution was transferred aseptically into separate petri dishes in duplicate. Twelve to fifteen ml of melted (and cooled to 45 °C) count agar was added to each plate. The plates were swirled gently and after the agar medium solidified, the plates were incubated for 48±2 h at 35 °C.

4.15.2 Detection and isolation of *Coliform* group:

Detection and isolation of Coliform group were followed using the method by Violet Red Bile Agar (VRBA). The following steps were applied: 25 g of cake sample were added to 225 ml of peptone water (0.1%), then mixed and homogenized. One ml of each dilution was putted in Petri dishes supplement with VRBA medium and incubated at 37ºc for 48 hours.

4.15.3 Isolation and detection of *E. coli:*

To isolate *E. coli* from Coliform groups, 100 μg of 4 Methyl- Umbelliferyl –Beta –D-Glucuronide (MUG) per 1.0 ml VRBA medium were added in medium overlay. The growth colonies were observed for fluorescent colonies under UV light (long wave).

4.15.4 Detection and isolation of *Staphylococcus aureus*:

Procedures detection of *S. aureus* were followed according to the method of FDA (1995). The following steps were complete confirmation:

1. Serial dilutions of cake samples (10^{-2}, 10^{-3}, 10^{-4}) were prepared.
2. One ml of each dilution was putted and spreaded under aseptic condition on the surface of Baird Parker agar medium and incubated at 35 ºC for 48 hr.
3. Selected colonies of *S. aureus* circular, smooth, convex, moist, 2-3 mm, gray to jet-black, with light- colors margin, and surrounding with opaque zone with outer clear zone were tested for coagulase and catalase.
4. Also the colonies were stained with Gram stain.
5. Latex agglutination test was used for further confirmation.

4.15.5 Detection and isolation of *Salmonella spp*:

Detection and isolation of *salmonella* species were followed according to the method of FDA (1995). The following steps were applied in order to complete confirmation:

1. Twenty five grams of cake added to 225 ml of lactose broth, then mixed and homogenized.
2. The mixture was transferred under aseptic condition to 500 ml jar, let stand 60 min at room temperature and incubate at 35ºC for 24 hour.
3. For enrichment, 2 ml of pre- enrichment mixture was transferred to 10 ml Selenite Cystine Broth (SCB) and Tetrathionate Brroth (TTB) (one ml for each broth) as well as incubated for 24 ±2 hr at 35ºC.
4. For more conformation, a loop of enriched culture was streaked onto Bismuth Sulphite AGAR (BSA), Xylose-Lysine Desoxycholate Agar (XLDA) and *salmonella*- *Shigella* Agar (SSA) and incubated for 24 ±2 hr at 35ºC.
5. Selected colonies from each medium were chosen as:

a. For BSA medium, brown, gray, or black colonies.
b. For SSA medium, black colonies.
c. For XLDA medium, pink colonies with black colour in centres.

6. Two or more typical colonies were inoculated onto plate of Triple Sugar Iron Agar (TSIA) and Lysine Iron Agar (LIA) media and incubated for 24 ±2 hr at 35ºC.
7. Chosen colonies were selective to achieve serological tests as followed:
   a. Colonies for urea negative TSIA slant were inoculated onto Trypticase soy tryptose (TST) broth and incubated at 35ºC/24 hr.
   b. 2.5 ml of formalinized physiological saline solution was added to 5 ml of TST broth culture and tested with polyvalent flagellar (H) antisera. Agglutination appear in test tube was observed.
   c. One drop of *Salmonella* poly valent somatic (O) anti serum was added to one drop of TST broth in a Petri dishes and mixed well. Agglutination result was recorded.

4.15.6 *Yeast* and *molds*:

Decimal dilutions (10^{-2}, 10^{-3}, 10^{-4}) of cake samples (prepared as described in preparation of the sample) were used. One ml of each dilution was transferred aseptically into the surface of a suitable media (Potato Dextrose agar and DRBC agar) and the plates were incubated for 5 days in dark at 22-25 ºC.

Notes: Count the plates containing 10-150 colonies.

4.16 Media which were used

4.16.1 Nutrient agar (Difco) for Heterotrophic Plate Count (H.P.C):

The typical formula (g/l): Bacto beef extract, 3.0; Bacto peptone, 5.0; Sodium chloride, 8.0 and Bacto agar, 15.0. Thirty one grams of the powder were suspended in one liter of distilled water, brought to boil to dissolve completely, and sterilized by autoclaving at 121 °C for 15 minutes. The final pH was adjusted to 7.3 ± 0.1 at 25 °C.

4.16.2 Peptone water (Oxoid) for dilution:

The typical formula (g/l): Peptone, 10.0 and Sodium chloride, 5.0. fifteen grams of Peptone water were dissolved in one liter of distilled water, mixed well and distributed into final containers. The medium was sterilized at 121 °C for 15 minutes. The final pH was adjusted to 7.2 ± 0.2.

4.16.3 Bacto Violet red bile agar (Difco) for coliform group bacteria and *E.coli*:

The typical formula (g/l): Bacto Yeast extract, 3.0; Bacto Peptone, 7.0; Bacto No. 3, 1.5; Bacto Lactose, 10.0; Sodium chloride, 5.0; Bacto Agar, 15.0; Neutral red and 0.03; Bacto Crystal violet, 0.002. 41.5 grams of the powder were suspended in one liter distilled water or deionized water and heated to boiling to dissolve completely. Medium was not autoclaved. The final pH was adjusted to 7.4 ± 0.2 at 25 °C.

4.16.4 Bacto Baird Parker agar (Difco) for *Staphylococcus aureus*:

The typical formula (g/l): Bacto Tryptone, 10.0; Bacto Beef extract, 5.0; Bacto Yeast extract, 1.0; Glycine, 12.0; Sodium pyruvate, 10.0; Lithium chloride, 5.0 and Bacto agar, 20.0. sixty three grams of the powder were suspended in 950 ml distilled or deionized water, heated to boiling to dissolve completely, and sterilized by autoclaving at 121 °C for 15 minutes. Cooling to 45 – 50 °C, meanwhile, warm (45 - 50 °C) Bacto Egg Yolk Tellurite enrichment supplement was added and mixed well with the prepared base. The final pH was adjusted to 7.0 ± 0.1 at 25 °C.

4.16.5 Lactose broth (Difco) for *Salmonella* Pre enrichment:

The typical formula (g/l): Bacto beef extract, 3.0; Bacto peptone, 5.0 and Bacto lactose, 5.0. Thirteen grams of the powder were dissolved in one liter of distilled water. The medium was sterilized at 121 °C for 15 minutes. The final pH was adjusted to 6.9 ± 0.2 at 25 °C.

4.16.6 Selenite F- broth (Difco) for Salmonella, enrichment:

The typical formula (g/l): Bacto tryptone, 5; Bacto lactose, 4.0; Disodium phosphate, 10.0; Sodium acid selenite, 4.0 and L – cystine, 0.01. Twenty three grams of the powder were dissolved in one liter of distilled water and heated to boil. The medium, without sterilization, was distributed into sterile cups to a depth at least 5 cm. The final pH was adjusted to 7.0 ± 0.2 at 25 °C.

4.16.7 S.S agar (Difco) for *Salmonella*:

The typical formula (g/l): Bacto beef extract, 5.0; Proteose peptone, Difco, 5.0; Bacto lactose, 10.0; Bacto bile salts No. 3, 8.5; Sodium citrate, 8.5; Sodium thiosulfate, 8.5; Ferric citrate, 1.0; Bacto agar, 13.5; Bacto brilliant green, 0.00033; and Bacto neutral red, 0.025. Sixty grams of the powder were suspended in one liter of distilled water and boiled for 2–3 minutes with frequent and careful swirling for complete dissolving. Medium was not sterilized, after cooling to 55–60°C, the medium was distributed into sterile petri dishes. The final pH was adjusted to 7.0°C ± 0.2 at 25 °C.

4.16.8 Bacto Bismuth sulfite agar (Difco) for *Salmonella*:

The typical formula (g/l): Bacto beef extract, 5.0; Bacto peptone, 10.0 ; Bacto dextrose, 5.0; Disodium phosphate, 4.0; Ferrous sulfate, 0.3; Bismuth sulfite indicator, 8.0; Bacto agar, 20.0 and Bacto brilliant green, 0.025. Fifty two grams of the powder were dissolved in one liter of distilled water and boiled. The medium is not autoclavaible. The final pH was adjusted to 7.7 ± 0.2 at 25 °C.

4.16.9 Bacto Xylose Lysine Desoxycholate (XLD) agar (Difco) for *Salmonella*:

The typical formula (g/l): Bacto yeast extract, 3.0; L-lysine, 5.0; Bacto xylose, 3.75; Bacto lactose, 7.5; Bacto saccharose, 7.5; Sodium desoxycholate, 2.5; Ferric ammonium citrate, 0.8; Sodium thiosulfate, 6.8; Sodium chloride, 5.0; Bacto agar, 15.0 and Bacto phenol red, 0.08. Fifty seven grams of the powder were suspended in one liter of distilled water and the mixture was boiled to dissolve completely. Medium was not autoclaved. The final pH was adjusted to 7.4 ± 0.2 at 25 °C.

4.16.10 Bacto Triple Sugar Iron (TSI) agar (Difco) for identification:

The typical formula (g/l): Bacto beef extract, 3.0; Bacto yeast extract, 3.0; Bacto peptone, 15.0; Proteose peptone, Difco, 5.0; Bacto dextrose, 1.0; Bacto lactose, 10.0; Bacto sucrose, 10.0; Ferrous sulfate, 0.2; Sodium chloride, 5.0; Sodium thiosulfate, 0.3; Bacto agar 12.0 and Bacto phenol red, 0.024. Sixty five grams of the powder were suspended in one liter of distilled water, boiled to dissolve completely. Medium was dispensed into tubes and sterilized in the autoclave for 15 minutes at 121° C. The final pH was adjusted to 7.4 ± 0.2 at 25 °C.

4.16.11 Lysine Iron agar (Difco) for identification:

The typical formula (g/l): Bacto peptone, 5.0; Bacto yeast extract, 3.0; Bacto dextrose, 1.0; L. lysine hydrochloride, 10.0; Ferric ammonium citrate, 0.5; Sodium thiosulfate, 0.04; Bacto bromo cresol purple, 0.02 and Bacto agar, 15.0. Thirty four and half grams of the powder were suspended in one liter of distilled water, boiled to dissolve completely. Medium was dispensed into tubes and sterilized in the autoclave for 15 minutes at 121 °C. The final pH was adjusted to 6.7 ± 0.2 at 25 °C.

4.16.12 Potato Dextrose Agar:

Code:CM139

A medium recommended for the detection and enumeration of *yeasts* and *moulds* in butter and other dairy and food products.

Formula	gm/liter
Potato extract	4.0
Glucose	20.0
Agar	15.0

pH 5.6±0.2

4.16.13 Directions:

Suspended 39g in liter of distilled water. Bring to the boil to dissolve completely. Sterilize by autoclaving at 121°C for 15 minutes. Mix well before pouring. In order to suppress bacterial growth it is sometimes desirable to acidify the medium to pH 3.5. This can be done by adding 1 ml of Lactic Acid 10% SR21 to each 100ml of sterilized medium at 50 °C. The medium must not be heated after the addition of the acid, this would result in hydrolysis of the agar and destroy its gelling properties.

4.17 Biochemical tests

The Analytical Profile Index (API) 20 E and API Staph strips (Bio Merieux) were used as the biochemical systems for identification of Gram- negative rod bacteria and Gram positive Cocci, respectively. The API 20 E and API Staph strip consist of 20 microtubes containing dehydrated substrates. These tests were inoculated with bacterial suspensions, which reconstitute the media. The strips were incubated for 18 to 24 hours at 37 °C. During the incubation, metabolism produces changes that are either spontaneous or revealed by the addition of reagents. The standards were scored according to a Reading Table and the identification was obtained by referring to the API catalogue (BioMerieux).

4.18 Data analysis

Data were analyzed by using Statistical Package for the social Sciences (SPSS) version 16. Descriptive analysis and frequency tables were conducted for different variables. Chi-Square was used to test the statistical association between component of questionnaire variables and also to test association between different types of microbes in contaminated samples. One-sample T test was used to compare the mean of the microbe load with the microbe standard limits. Independent-samples T test was used to compare between the means of various types of microbes. P value less than 0.05 was considered statistically significant. Odds Ratio was used for measurement of risk at 0.95 confidence interval (C.I) for statistical significant.

Chapter 5

Results and discussion

5.1 Questionnaire results

5.1.1 Personal data of cake workers:

5.1.1.1 General characteristics of the study population:

Table 5.1 illustrates general characteristics of cake workers (n=90). A total of 41 (45.6%) and 39 (43.3%) were found to live in the old and new Gaza suburbs respectively and 10 (11.1%) workers live out of the Gaza Governorate. Almost all workers were males 89 (98.9%). For our cultural reasons females were not engaged in such activities. The mean age of the study population was 29.9 years with age group 21-30 years represented the highest percentage (46.7%). Analysis of the educational status of the cake workers showed that 19 (21.1%) had a university degree, 37 (41.1%) had finished secondary school, 25 (27.8%) had finished preparatory school, 9 (10.0%) had passed primary school, and none were illiterate. This reflects a well educated community and may give the impression that the high rate of educated cake workers is a result of not getting another job because of the unemployment crisis in the Gaza Strip. In addition, seventy one (78.9%) workers were smokers. More than half of workers (58.9%) hade experience for ≤5 years. Regarding position in the work, the majority of workers 66 (73.3%) were workers and the rest of them were owners 24 (26.7%). Thirty eight workers (42.2%) were trained whereas fifty two workers (57.8%) were not trained. (Van Tonder, et al, 2007) pointed out that although the majority of food handlers adhered to basic hygiene principles, there is definitely a need for proper and continuous training in personal and general hygiene, not only for food handlers, but also for management.

Table 5.1: General characteristics of the cake workers (n= 90).

General characters	Frequency	Percentage
Address		
Old Gaza suburb	41	45.6
New Gaza suburb	39	43.3
Out of Gaza Governorate	10	11.1
Gender		
Male	89	98.9
Female	1	1.1
Age (Year)		
≤20	11	12.2
21-30	42	46.7
31-40	29	32.2
≥40	8	8.9
Education		
University	19	21.1
Secondary	37	41.1
Preparatory	25	27.8
Primary	9	10.0
Illiterate	0	0
Smoking	71	78.9
Experience (Year)		
≤5	53	58.9
6-10	13	14.4
11-20	19	21.1
>20	5	5.6
Position in the work		
Owner	24	26.7
Worker	66	73.3
Training		
Have been trained	38	42.2
Haven't been trained	52	57.8

5.1.2 Personnel hygiene:

5.1.2.1 Health status:

Table 5.2 illustrates the health status of the cake workers (n=90). A total of 70 (77.8%) workers had medical examination. Fourteen of them (20.0%) had got medical prescription for treatment. They were forbidden to continue their work until recovery and repeated examination until become negative. World Health Organization (WHO, 1996) stated that food handlers may act as a source of food contamination through inadequate personal hygiene or when handling food while they are medically unfit. Public Health Law No. (20/2004) provided that It is not permissible to license any individual infected with any infectious disease, to work as a food or beverage vendor. Regarding workers, infection, 11 (12.2%) workers stayed at work whereas 79 (87.8%) stayed at home. Out of all workers five (5.6%) workers changed their work duties and six (6.7%) did not. In addition, the number of workers who stayed at work and protect their injuries or abscises using protective waterproof was 22 (24.4%) and those who leave the work place were 68 (75.6%). Workers with infection, who stayed at work and didn't change their duties, could be a potential source of cake contamination (Pereira, et al, 1994). And (Mortimore and Wallace, 1998) reported cake contamination by the food handler with *S. aureus* that produced *enterotoxin* which was isolated from the nose, the fingernails, and a healed infection on the neck of the cake handler.

Table 5.2 Health status of cake workers (n= 90).

Health status	Yes Frequency (%)	No Frequency (%)
Have medical examination	70 (77.8)	20 (22.2)
Got medical prescription (n=70)	14 (20.0)	56 (80.0)
Stay at work in case of infection	11 (12.2)	79 (87.8)
Stay but change his duties (n=11)	5 (5.6)	6 (6.7)
Stay at work and protect injuries in case of injuries or abscises	22 (24.4)	68 (75.6)

5.1.2.2 Personal cleanliness:

Personal cleanliness of the workers (n=90) is summarized in Table 5.3. The number of workers who mentioned cutting their nails, wearing special white uniform and keeping their work clothes in special place during work were 88 (97.8%), 67 (74.4%) and 70 (77.8%) respectively. Forty three (47.8%) workers changed their dress daily. The rest of them 47 (52.2%) changed their dress 14 (29.8%) every two days, 8 (17.0%) every three days, 5 (10.6%) every week and 20 (42.6%) when their dress become dirty. The workers who wearing gloves were 54 (60.0%) and those who did not were 36 (40.0%). Out of the 54 workers, 5 (9.3%) workers did not change gloves. The large number of workers registered in the present study, who didn't wear gloves during work, could be a real source of contamination. (Friedman, et al, 2005) stated that food poising with norovirus by cake consumption was mainly caused by hand contact during preparation. (Also Prato, et al, 2006) reported that food outbreak with hepatitis A referring the contamination was a food handler. Concerning hand washing, the number of workers who claimed hand washing before starting work, after toilet, after smoking, after touching clothes and hair, after changing duties, after eating, after removing wastes and after dealing with raw materials were 82 (91.1%), 90 (100.0), 58 (81.7%), 68 (75.6%), 75 (83.3%), 86 (95.6%), 90 (100.0%), and 86 (95.6%), respectively. Fifty seven (63.3%) workers used antiseptics after washing their hands while 33(36.7%) did not. These data indicated that cake workers had good personal hygiene in respect to hand washing. (Dumavibhat, et al, 1989) revealed one to eight bacterial species harbored hands and nails of food handlers before hand washing. However, after hand washing disappearance of one to four bacterial strains from hands and nails were found in 47% of food handlers. Microbial contaminant easily transmitted to any food by handling and poor hygienic practices (Mortimore and Wallace, 1998) and (Warren, et al, 2006). Pan American Health Organization and World Health Organization, (PAHO, WHO, 2001). recommended that hand-washing facilities should be adequate and convenient and be furnished with running water at a suitable temperature. Compliance with this requirement may be accomplished by providing hand-washing and hand-sanitizing facilities at each location in the plant. Effective hand-cleaning and sanitizing products including sanitary towel service or suitable drying devices or fixtures such as water control valves should be designed and constructed to protect against recontamination of clean and sanitized hands. Employees who handle unprotected food, packaging materials or food-contact surfaces must wash and sanitize their hands before they start work, after each absence from their post of duty and when their hands may have become soiled or contaminated.

Table 5.3: Personal cleanliness of cake workers (n= 90).

Personal cleanliness	Yes Frequency (%)	No Frequency (%)
Cut nail	88 (97.8)	2 (2.2)
Wearing special white uniform	67 (74.4)	23 (25.6)
Keeping work clothes in special place	70 (77.8)	20 (22.2)
Changing dress		
Daily (n=90)	43 (47.8)	47 (52.2)
Every two days (n=47)	14 (29.8)	33(70.2)
Every three days (n=47)	8 (17.0)	39(83.0)
Weekly (n=47)	5 (10.6)	42(89.4)
When dirty (n=74)	20 (42.6)	27(57.4)
Wearing gloves	54 (60.0)	36 (40.0)
Changing disposal gloves (n=54)	49 (90.7)	5 (9.3)
Hand washing		
Before starting work	82 (91.1)	8 (8.9)
After toilet	90 (100)	0 (0.0)
After smoking(n=71)	58 (81.7)	13 (18.3)
After touching clothes and hair	68 (75.6)	22 (24.4)
After changing duties	75 (83.3)	15 (16.7)
After eating	86 (95.6)	4 (4.4)
After removing wastes	90 (100)	0 (0.0)
After dealing with raw material	86 (95.6)	4 (4.4)
Using antiseptic after washing hands	57(63.3)	33(36.7)

5.1.2.3 Personnel behavior:

Personal behavior of cake workers during the work is presented in Table 5.4. Thirteen (14.4%) workers stated that they wear rings during work while 77 (85.6%) did not. The number of workers who didn't apply the role of not smoking, eating and spotting in the area of the work was 8 (8.9%). In addition, a total of 6 (6.7%) workers didn't covered mouth and nose when coughing or sneezing and 13 (14.4%) workers didn't washed hands after sneezing. Personal behavior of some cake workers reported here was unacceptable and could be a serious source of contamination. (Codex (1999) recommend that people engaged in food processing should avoid any behavior that could result in food contamination. Smoking, spitting, chewing or eating, sneezing or coughing directly over food is unacceptable because it increases the probability of contamination. Personal effects such as jewelry, watches, pins or other such items should not be worn or brought into food handling areas if they pose a threat to the safety and suitability of food.

Table 5.4: Personnel behavior of cake workers during work (n= 90).

Personnel behavior during work	Yes Frequency (%)		No Frequency (%)	
Wearing rings	13	14.4	77	85.6
Smoking, spotting and eating	8	8.9	82	91.1
Covering mouth and nose when coughing or sneezing	84	93.3	6	6.7
Washing hands after sneezing	77	85.6	13	14.4

5.1.3 Knowledge of cake workers:

Table 5.5 summarized various aspects of cake workers' knowledge on microbes, their sources, growth and food safety. When asked 'What is the microbe?' eighteen (20.0%), 2 (2.2%), 2 (2.2), 5 (5.6%), 33 (36.7%) workers said that microbes is *bacteria*, *molds*, *yeast*, *virus* and all of them, respectively while 30 (33.3%) said that they do not know. The majority of workers 70 (77.8%) reported that microbes are harmful. Regarding workers' knowledge on the source of contamination, 7 (7.8%), 8 (8.9%), 1(1.1%) and 74 (82.2%) workers mentioned that workers, tools, ingredients and all of them are the source of contamination. Most workers 84 (93.3%) had high level of knowledge on microbial growth. The number of workers who knew that temperature, pH, food and all of them are suitable conditions for microbial growth were 8 (8.9%), 6 (6.7%), 18 (20.0%), 29 (32.2%). However, 29 (32.2%) do not know. Workers who had knowledge about microbial food spoilage were 81 (90.0%). Forty seven (52.2%) workers claimed that they heard about food poisoning and 43 (47.8%) did not. The previous results implied that cake workers had good knowledge on microbes, their sources, growth and food safety. Most workers knew what is the microbe and the suitable condition for its growth. However, they can not distinguish either between the different types of microbes or between the various suitable conditions for its growth. Data presented here are in agreement with that reported by (Henroid and Sneed, 2004) who evaluated food safety knowledge of employees and found that they had a significant amount of food safety knowledge (15.9+/-2.4 out of 20 possible points). Despite their relatively high knowledge reported in the present study, cake workers still need educational programs.

Table 5.5: Knowledge of cake workers on microbes, their sources, growth and food safety (n= 90).

Knowledge of cake workers	Frequency	Percentage
The microbe is		
Bacteria	18	20.0
Mold	2	2.2
Yeast	2	2.2
Virus	5	5.6
All above	33	36.7
Don't know	30	33.3
Health effect of microbe		
Useful	3	3.3
Harmful	70	77.8
both (Useful& Harmful)	9	10.0
Don't know	8	8.9
Source of contamination		
Workers	7	7.8
Tools	8	8.9
Ingredients	1	1.1
All above	74	82.2
Microbe growth		
Yes	84	93.3
No	6	6.7
Suitable factors for microbial growth		
Temperature	8	8.9
PH	6	6.7
Food	18	20.0
All above	29	32.2
Don't know	29	32.2
Do you think microbes spoil the food		
Yes	81	90.0
No	9	10.0
Hearing about food poising		
Yes	47	52.2
No	43	47.8

5.1.4 Practice of cake workers:

5.1.4.1 Cake workers practice related to ingredients:

Practice of cake workers related to ingredients is given in Table 5.6. The majority of cake workers 84 (93.3%) claimed that they purchased the ingredients from credit retailers. Although 77 (85.6) workers checked the ingredients before receiving, while 13 (14.4%) workers still did not checked the ingredients. Most workers 83 (92.2) stored the ingredients in special place. In addition, almost all workers 89 (98.9) applied first in first out system. All workers did not use unacceptable ingredients for cake making; either they return them to the source 64 (71.1%) or destroyed them 26 (28.9%). Although workers had good practice in relation to ingredients, checking and storing of ingredients still constitute risk factors in cake contamination. Broken raw liquid eggs and contaminated eggs are reported to be associated with outbreaks of food borne illness (Leasor and Foegeding, 1989),(Hobbs and Roberts, 1993) and (Stephens, et al, 2007). (Serra Bonvehi, 2004) mentioned that the chocolate and coccao ingredient in cake caused food outbreak with ochratoxin. In addition, *S. aureus* was isolated from raw milk (Moon, et al, 2007).

Table 5.6: Practice of cake workers related to ingredients (n= 90).

Practice related to ingredients	Frequency	Percentage
Purchasing the ingredient from credit retailers		
Yes	84	93.3
No	3	3.3
Both	3	3.3
Checking the ingredient before receiving		
Yes	77	85.6
No	13	14.4
Storing the ingredient in special place		
Yes	83	92.2
No	7	7.8
Applying first in first out system		
Yes	89	98.9
No	1	1.1
Unacceptable ingredients		
Back them to the source	64	71.1
Destroy them	26	28.9
Use them	0	0

5.1.4.2 Practices related to pest control in the plant:

Summarized practices related to pest control in the plant shown in Table 5.7. Eighteen (20.0%) workers mentioned that pest had caused problems in the plant while 72 (80.0%) had the opposite response. A total of 79 (87.8%) cake workers stated that pest control is applied in the plant. Pest preventive actions applied in the plant, as reported by workers, included screening windows 11 (12.2%), closing doors 3 (3.4%), maintaining cracks 1 (1.1%), keeping place cleaned 21 (23.3%) and applied all of them 54 (60.0%). The common types of insect control, as stated by workers, were chemical 36 (40.0%), electrical 29 (32.2%) and then mechanical 3 (3.3%) respectively. Rodent control was mainly chemical 30 (33.3%) and mechanical 24 (26.7%). Seventy (77.8%) workers and 20 (22.2%) experts had been involved in pest control. The majority of workers 82 (91.1%) stored toxic chemicals used to fight pests in special place. Previous data indicated the presence of pest control activities which are necessary to minimize food contamination. It is known that pest spoils food and acts as a vector for many pathogenic organisms (Malik, et al, 2007). In addition, many surfaces not directly in contact with food may harbor microorganisms, e.g. non-food contact equipment surfaces, walls, floors, drains, overhead structures. These microorganisms can then be transferred to the food in the air via water droplets, dust and pest including insects and rodents (Codex, 2003).

Table 5.7: Practices related to pest control in the plant.

Practice related pest control	Frequency	Percentage
Pest caused problems		
Yes	18	20
No	72	80
Application of pest control		
Yes	79	87.8
No	11	12.2
Type of control		
Screening windows	11	12.2
Closing doors	3	3.4
Maintaining the cracks	1	1.1
Keeping the place cleaned	21	23.3
All above	54	60.0
Type of insect control		
Mechanical	3	3.3
Chemical	36	40.0
Electricity	29	32.2
Mechanical+ Chemical	5	5.6
Mechanical+ Electricity	1	1.1
Chemical+ Electricity	5	5.6
Mechanical+ Chemical+ Electricity	11	12.2
Type of rodent the control		
Mechanical	24	26.7
Chemical	30	33.3
Electricity	1	1.1
Mechanical+ Chemical	12	13.3
Mechanical+ Electricity	4	4.4
Chemical+ Electricity	3	3.4
Mechanical+ Chemical+ Electricity	16	17.8
Pest control by		
Plant workers	70	77.8
Expert	20	22.2
Storing chemicals in special place		
Yes	82	91.1
No	8	8.9

5.1.4.3 Cake workers practice related to cleaning and disinfecting of tools and equipments:

The practice of cake workers related to cleaning and disinfecting tools and equipments is shown in table 5.8. All workers 90 (100.0%) reported cleaning of tools and equipments; fourteen (15.5%) workers mentioned that they cleaned tools and equipments when they become dirty, 17 (18.9%) workers cleaned them at changing cake preparing step, 26 (28.9%) cleaned at the end of work and 33 (36.7%) did all the former practices. The majority of workers 85 (94.4%) claimed that they removed the remaining particles of food present on equipment and tools; most workers 63 (74.1%) did so by abrasion process. All workers 90 (100.0%) used cleaning material; 52 (57.8%) used liquid soup, 4 (4.4%) used paste soap and 34 (37.8%) used both liquid and paste soap. Concerning disinfections of tools and equipments, 54 (60.0%) workers made disinfection; half of them used boiling water, 16 (29.6%) used warm water and 11 (20.4%) used nearly boiling water for disinfection. Most workers 85 (94.4%) stored dried utensils in special clean place. The above mentioned data indicate that there is a need for workers to apply immediate cleaning of tools and equipments and in between cake preparation steps. (Evans, et al, 1996) investigated food poising with *salmonella* from eating cake. The cause was cross contamination during the preparation, inadequate cleaning and disinfectant equipments. An association of bacteria with cleaning tools, such as floor mops and cleaning cloths and handling devices, such as disposable plastic gloves was found (Christison, et al, 2007). It was recommended that sanitation activities should be carried out during operations. At a minimum, these pre-operational procedures must address the cleaning of food contact surfaces of facilities, equipment, and utensils. However running water at a suitable temperature, shall be provided in all areas where required for the processing of food, for the cleaning of equipment, utensils, and for employee sanitary facilities.

Table 5.8: Practice of cake workers related to cleaning and disinfecting of tools and equipments (n= 90).

Practice related to cleaning and disinfecting	Frequency	Percentage
Cleaning of tools and equipments (n=90)		
When it became dirty	14	15.5
At changing cake preparing step	26	28.9
At the end of the work	17	18.9
All above	33	36.7
Removing the remaining food particles (n=85)		
Water immersion	8	9.4
Running water	14	16.5
Abrasion	63	74.1
Using cleaning materials		
Liquid soap	52	57.8
Paste soap	4	4.4
Liquid and paste	34	37.8
Disinfection of tools and equipments (n=54)		
Warm water	16	29.6
Nearly boiling water	11	20.4
Boiling water	27	50.0
Storing dried utensils in special cleaned place		
Yes	85	94.4
No	5	5.6

5.1.4.4 Cake workers practice related to solid waste container and wastewater:

Table 5.9 illustrates the practice of cake workers related to solid waste container and wastewater. All workers admitted the use of solid waste container; 74 (82.2%) used containers with well closed lid and 16 (17.8%) used containers without lid. Thirty five (38.9%) workers removed solid wastes when container filled, 38 (42.2%) at the end of the work and 17 (18.9%) when sanitation worker come. The majority of workers 65 (72.2%) cleaned the container after removing solid wastes. Concerning wastewater drainage, 81 (90.0%) workers said that wastewater is drained through sewage network, 7 (7.8%) said that wastewater is discharged in absorb wells and 2 (2.2%) claimed that wastewater is discarded in the vicinity. The present data necessitates the use of containers with well closed lids and immediate removal of solid wastes. Rubbish and any offal should be so conveyed, stored, and disposed off as to minimize the development of odor, minimize the potential for the waste to draw, harbor or breed pests, and protect against contamination of food. Adequate drainage and waste water system and facilities should be provided. They should be designed and constructed so that the risk of contaminating food or the potable water supply is avoided.

Table 5.9: Practice of cake workers related to solid waste container and wastewater (n=90).

Practice related to solid waste container and wastewater	Frequency	Percentage
Using solid waste container		
Closed well with lid	74	82.2
Without lid	16	17.8
Removing solid wastes		
When container filled	35	38.9
At the end of the work	38	42.2
When the sanitation worker come	17	18.9
Cleaning the container after removing		
Yes	65	72.2
No	25	27.8
Waste water drainage		
Through sewage network	81	90.0
Discharged in absorb well	7	7.8
discarded in the vicinity	2	2.2

5.1.4.5 Cake workers practice related to product process and preservation:

Practice of cake workers related to product process and preservation is summarized in Table 5.10. The majority of workers 86 (95.6%) said that the process line arrange steps follow each others. Selling cake in the plant was mentioned by 82 (91.1%) workers. Twenty eight workers (31.1%) stored the product and ingredients in the same refrigerator whereas 62 (68.9%) stored them separately. Most workers 84 (93.3%) admitted that refrigerator has temperature indicator. Storage temperature was reported to be 5-10^{o}C by more than half of workers 50 (55.5%). Most workers 81 (90%) claimed that they did not add chemical preservatives. Also, 87 (96.7%) workers reported frequent internal inspection. The types of packaging materials used were paper carton 51 (56.7%), 10 (11.1) plastic and others 29 (32.2%). All workers claimed that the used packaging materials were clean. Finally most workers 82 (91.1%) stated that packaging materials stored in special place. Storage of products and ingredients at temperature exceeding 10^{o}C give a chance for microbes to grow and multiply causing food contamination and spoilage. (Escartín, et al, 1998) reported that when mocha cake was stored at 30ºC, *S. aureus* increased in number by more than 4 log after 48 h. On the other hand, *S. aureus* did not grow in the cake stored at 4-7ºC. (Dippold, et al, 2003) and (Levy, et al, 2003) revealed that food-handling practices and food handler perceptions may have contributed to disease transmission.

Table 5.10: Practice of cake workers related to product process and preservation.

Practice related to product process and preservation	Percentage	Frequency
Production line arranged as the chain		
Yes	86	95.6
No	4	4.4
Selling cake in the plant		
Yes	82	91.1
No	8	8.9
Storing product & ingredient in the same refrigerator		
Yes	28	31.1
No	62	68.9
Are the refrigerators having temperature indicators		
Yes	84	93.3
No	6	6.7
Temperature of storage		
Less than 5°c	24	26.7
5°c -10°c	50	55.5
More than 10°c	7	7.8
Don't know	9	10.0
Addition of chemicals preservative		
Yes	9	10.0
No	81	90.0
Internal inspection has been done		
Yes	87	96.7
No	3	3.3
Type of packaging material		
Paper (Carton)	51	56.7
Plastic	10	11.1
Others	29	32.2
Packaging material are used clean		
Yes	90	100
No	0	0.0
Packaging material stored in special place		
Yes	82	91.1
No	8	8.9

5.1.5 Cake workers attitude:

Table 5.11 shows cake workers attitude towards plant area, training, motivation and GHP. Where sixty (66.7%) and 70 (77.8%) workers agreed to increase the plant area and the need for more training. A total of 67 (74.4%) workers claimed that they have enough motivation towards work whereas 23 (25.6%) had the opposite opinion. The majority of workers 82 (91.1%) had the attitude to apply GHP during the process of cake production. (Fraser, 2002) stressed on the importance of adequate training and proper supervision. (Van Tonderet, al, 2007) added that there is definitely a need for continuous training in personal and general hygiene, not only for food handlers, but also for management.

Table 5.11: Cake workers attitude toward plant area, training, motivation and GHP (n= 90).

Cake workers attitude	Frequency	Percentage
Increasing the area of the plant		
Yes	60	66.7
No	30	33.3
Need more training		
Yes	70	77.8
No	20	22.2
There is enough motivation		
Yes	67	74.4
No	23	25.6
Applying GHP during process of cake production		
Yes	82	91.1
No	08	08.9

5.1.6 Cake plant facilities and general health conditions:

Cake plant regulation, facilities and general health conditions are presented in Table 5.12. Showing that seventy two (80.0%) workers claimed that the plants are licensed while 18 (20%) said not. Out of 72, 59 (81.9%) workers admitted that plants had renewed licenses. Most workers 54 (60.0%) mentioned that the plant is mainly inspected by the Ministry of Health. Concerning plant facilities, 83 (92.3%), 85 (94.4%), 79 (87.8%), 89 (98.9%) workers stated that the plant have smooth and easily cleaned floor, well ventilated, had good lightening and had concrete ceiling, respectively. Workers' response on water facility in the plant revealed that municipal water is the main source of water in the plant 83 (92.2%), additional water reservoir existed in the plant 85 (94.4%), plastic water tanks were commonly used 85 (94.4%) and cleaning and disinfection of the tanks were frequently achieved 81 (90.0%). Regarding plant tools, 70 (77.8%) and 88 (97.8%) workers said that plant tools made from stainless steel and they were smooth, respectively. Ventilation systems should be designed and constructed so that air does not flow from contaminated areas to clean areas and, where necessary, they can be adequately maintained and cleaned. Adequate natural or artificial lighting should be provided to enable the undertaking to operate in a hygienic manner.

Table 5.12: Cake plant regulations, facilities and general health conditions.

Cake plant regulation, facilities and general health conditions	Frequency	Percentage
Plant regulations		
Have license		
Yes	72	80.0
No	18	20.0
Renew the license		
Yes	59	81.9
No	13	18.1
Organization that run inspection		
MOH	54	60.0
Municipality	01	01.1
MOH & Municipality	35	38.9
Plant facilities		
Floor		
Smooth and easily cleaned	83	92.3
Not smooth	04	04.4
Cleavages	3	3.3
Ventilation		
Enough	85	94.4
Not enough	05	05.6
Lightening		
Good	79	87.8
Acceptable	9	10.0
Not acceptable	2	02.2
Type of the ceiling		
Concrete	89	98.9
Asbestos	0	0.0
Metal roof	1	1.1
Others	0	0.0
Water in the plant		
Source of water used		
Municipality	83	92.2
Special well	1	1.1
Others	6	6.7
Additional water reservoir		
Yes	85	94.4
No	5	5.6
Type of the water tank		
Plastic	85	94.4
Metal	5	05.6
Other	0	0.0
Cleaning and disinfecting water tank		
Yes	81	90.0
No	9	10.0
Plant tools		
Tools made from	70	77.8
Stainless steel	1	1.1
Iron	13	14.4
Stainless steel+ Aluminum	6	6.7
All of them		
Tools' smoothness	88	97.8
Yes	2	2.2
No		

5.2: Microbial results

5.2.1 Total bacteria count:

5.2.1.1 Group frequency of total bacteria count:

Table 5.13 shows group frequency of total bacteria count (TBC) per gm in all collected samples (173). A total of 148 (85.5%) samples were contaminated. The highest number of tested samples 46 (26.6%) was found to have TBC range of >10 e4 to 10 e5. According to the TBC limit (TBC<10e5), 24 (13.9%) cake samples are considered unacceptable.

Table 5.13: Groups frequency of total bacteria count (n=173).

T.B.C range	Sample	
	No.	%
0	25	14.5
11-100	08	04.6
101 -1000	27	15.6
1001 -10000	43	24.9
10001 -100000	46	26.6
***100001 -1000000**	21	12.1
1000001>	03	01.7
total	173	100.0

***=** the number considered more than the limit(the samples unaccepted)

5.2.1.2 Group frequency of *total bacteria count* according to the plant license and location:

Group frequency of total bacteria count according to the plant license and location is illustrated in Table 5.14. The numbers of collected cake samples from licensed and unlicensed plants were 124 and 49, respectively. A total of 105 (84.7%) and 43 (87.8%) samples from licensed and unlicensed plants were found to be contaminated. The highest number of tested samples 38 (30.6%) from licensed plant was found to have TBC range of >10 e4 to 10 e5 whereas those from unlicensed plant 15 (30.6%) was found to have TBC range of >10 e3 to 10 e4. According to the TBC limit, 16 (12.9%) and 8 (16.3%) cake samples from licensed and unlicensed plants were unacceptable. Concerning plant location, the number of collected cake samples from new and old Gaza plants were 128 and 45, respectively. A total of 106 (82.8%) and 42 (93.3%) samples from new and old Gaza plants were found to be contaminated. The highest number of tested samples 37 (29.9%) from the new Gaza plant was found to have TBC range of >10 e4 to 10 e5 whereas those from the old Gaza plant 14 (31.1%) was found to have TBC range of >10 e2 to 10 e3. According to the TBC limit, 22 (17.2%) and 2 (4.4%) cake samples from new and the old Gaza plants were unacceptable.

Table 5.14: Groups frequency of Total Bacteria Count according to plant license and location.

TBC range	License Plant	Unlicensed Plant	New Gaza	Old Gaza
	Sample No. (%)	**Sample No. (%)**	**Sample No. (%)**	**Sample No. (%)**
0	19 (15.3)	6 (12.2)	22(17.2)	3 (6.7)
11-10e2	8 (6.5)	0 (0.0)	4 (3.1)	4 (8.9)
101-10e3	15 (12.1)	12 (24.5)	13 (10.2)	14 (31.1)
1001-10e4	28 (22.6)	15 (30.6)	30 (23.4)	13 (28.9)
10001-10e5	38 (30.6)	8 (16.3)	37 (28.9)	9 (20.0)
***100001-10e6**	13 (10.5)	8 (16.3)	19 (14.8)	2 (4.4)
1000001>	3 (2.4)	0 (0.0)	3 (2.3)	0 (0.0)
Total	124 (100)	49 (100)	128 (100)	45 (100)

***=** the number considered more than the limit(the samples unaccepted)

5.2.1.3 *T.B.C* distributed of central tendency measures according to plant license and location:

Table 5.15 presents T.B.C distributed of central tendency measures according to plant license and location. The mean value of TBC for all collected samples (n=173) was 1.01e5±327045.7 (range 0 to 3e6). Sample tested from licensed plants (n=124) had mean TBC of 1.22e5±381679.6 (range 0 to 3e6) whereas those from unlicensed plants (n=49) had mean TBC of 4.86e4±77423 (range 0 to 3e5). Concerning plant location, the mean TBC in sample collected from new Gaza plants (n=128) was 128520.8±375873.8 (range 0 to 3e6) whereas that of samples collected from old Gaza plants (n=45) was 24411±46060.7 (range 0 to 2e5). T. test revealed that the mean TBC of all samples (1.01e5) was higher than the TBC limit (1e5). However, the difference between the two means was not statistically significant (P=0.95). Also, TBC mean of the samples collected from licensed plants exceeded that of TBC limit, but the difference was not statistically significant (P=0.51). On the other hand, TBC mean of the samples collected from unlicensed plants was significantly lower than TBC limit (P=0.00). T. test showed that the mean TBC of cake samples collected from licensed plant was higher than that of samples collected from unlicensed plants (P=0.18). Also, TBC of cake samples collected from new Gaza plant was higher than that of samples collected from old Gaza plants (P=0.06).

Table 5.15: T.B.C distributed of central tendency measures according to plant license and location.

Item	Sample No.	T.B.C			
		Min.	Max.	Mean	Std.
Total collected	173	0	3e6	1.01e5	327045.7
License Plant	124	0	3e6	1.22e5	381679.6
Unlicensed Plant	49	0	3e5	4.86e4	77423. 1
New Gaza suburb	128	0	3e6	128520.7	375873.
Old Gaza suburb	45	0	2e5	24411.1	46060.7

5.2.1.4 Distribution of compliance Total Bacteria Count samples according to plant license and location:

Distribution of compliance Total Bacteria Count samples according to plant license and location is given in Table 5.16. Out of 124, 108 (87.1%) cake samples produced by licensed plants were compliance with TBC limits whereas 41 of 49 (83.7%) samples produced by unlicensed plants were compliance with TBC limits. The difference between the two groups was not statistically significant (P=0.55). Concerning plant location, the number of samples showed compliance from the new and old Gaza plants were 106 of 128 (82.8%) and 43 of 45 (95.6%), respectively. However, the difference between the two groups was statistically significant (P=0.03).

Table 5.16: Distribution of compliance Total Bacteria Count samples according to plant license and location.

Collected samples from	Sample No.	≤10 e5 Compliance	> 10 e5 incompliance	Odds Ratio	P-value
		No. (%)	No. (%)	Value (95% CI)	
License plant	124	108 (87.1)	16 (12.9)	1.317 (0.5-3.3)	0.55
Unlicensed plant	49	41 (83.7)	8(16.3)		
New Gaza suburb	128	106 (82.8)	22 (17.2)	4.462 (1.01-19.8)	0.03
Old Gaza suburb	45	43 (95.6)	2 (4.4)		

5.2.2 *Staphylococcus. aureus*:

5.2.2.1 Groups frequency of *S. aureus*:

Table 5.17 shows group frequency of *S. aureus* per gm in all collected samples (173). A total of 30 (17.3%) samples were contaminated. The highest number of tested samples 17 (9.8%) was found to have *S. aureus* range of >10 e3 to 10 e4. According to the *S. aureus* limit (*S. aureus* ≤10 e2), 29 (16.8%) cake samples are considered unacceptable.

Our finding that *S. aureus* was found in 30 of 173 samples (17.3%) agreed with that reported by (Pereira, et al, 1994) who found that cake was accidentally contaminated by food handler with *S. aureus*. In addition (Escartín, et al, 1998) reported that a foodborne outbreak due to *S. aureus enterotoxin* associated with the consumption of contaminated mocha cake.

Table 5.17: Groups frequency of *S. aureus* according to plant license and location.

***S .aureus* range**	**Sample**	
	No.	**%**
0	143	82.5
11-100	01	00.6
***101 -1000**	11	06.4
1001 -10000	17	09.8
10001>	01	00.6

***=** the number considered more than the limit (the samples unaccepted)

5.2.2.2 Group frequency of *Staphylococcus aureus* according to plant license and location:

Group frequency of *S. aureus* according the plant license and location is illustrated in Table 5.18. The numbers of collected cake samples from licensed and unlicensed plants were 124 and 49, respectively. A total of 21 (16.9%) and 9 (18.4%) samples from licensed and unlicensed plants were found to be contaminated. The highest number of tested samples 12 (9.7%) from licensed plant was found to have *S. aureus* range of 10 e3 to 10 e4 whereas those from unlicensed plant 5 (10.2%) was found to have *S. aureus* range of 10 e3 to 10 e4. According to the *S. aureus* limit, 20 (16.1%) and 9 (18.4%) cake samples from licensed and unlicensed plants were unacceptable. Concerning plant location, the number of collected cake samples from new and old Gaza plants were 128 and 45, respectively. A total of 24 (18.7%) and 6 (13.3%) samples from new and old Gaza plants were found to be contaminated. The highest number of tested samples 15(11.7%) from new Gaza plant was found to have *S. aureus* range of 10 e3 to 10 e4 whereas those from old Gaza plant 3(6.7%) was found to have *S. aureus* range of 10 e2 to 10 e3. According to the *S. aureus* limit, 24 (18.8%) and 5 (11.1%) cake samples from new and old Gaza plants were unacceptable.

Table 5.18: Group frequency of *S. aureus* according to plant license and location.

S. aureus Range	License Plant	Unlicensed Plant	New Gaza	Old Gaza
	Sample No. (%)	Sample No. (%)	Sample No. (%)	Sample No. (%)
0	103(83.1)	40(81.6)	104(81.2)	39(86.4)
11-10e2	1(0.8)	0(00.0)	0(0.0)	1(2.2)
***101-10e3**	7(5.6)	4(8.2)	8(6.2)	3(6.7)
1001-10e4	12(9.7)	5(10.2)	15(11.7)	2(4.4)
10001-10e5	1(0.8)	0(0.0)	1(0.8)	0(0.0)
Total	124(100)	49	128(100)	45(100)

***=** the number considered more than the limit (the samples unaccepted)

5.2.2.3 *S. aureus* distributed of central tendency measures according to pant license and location:

Table 5.19 presents *S. aureus* distributed of central tendency measures according to plant license and location. The mean value of *S. aureus* for all collected samples (n=173) was 635.8±2689.6 (range 0 to 3e4). Sample tested from licensed plants (n=124) had mean *S. aureus* of 716.1±3091.5 (range 0 to 3e4) whereas those from unlicensed plants (n=49) had mean *S. aureus* of 432.7±1171.4 (range 0 to 6e3). Concerning plant location, the mean *S. aureus* in sample collected from the new Gaza plants (n=128) was 803.9±3095.6 (range 0 to 3e4) whereas that of samples collected from the old Gaza plants (n=45) was 157.8±551.6 (range 0 to 3e3). One sample T test revealed that the mean *S. aureus* of all samples (635.8) was higher than the *S. aureus* limit (10e2) where T=2.6 however, the difference between the two means was statistically significant (P=0.01). Also, *S. aureus* mean of the samples collected from licensed plants exceeded that of *S. aureus* limit, and the difference was statistically significant (P=0.02). On the other hand, *S. aureus* mean of the samples collected from unlicensed plants was significantly higher than *S. aureus* limit (P=0.05). T sample test showed that the mean *S. aureus* of cake samples collected from licensed plant was higher than that of samples collected from unlicensed plants (P=0.53). Also, *S. aureus* of cake samples collected from the new Gaza plant was higher than that of samples collected from the old Gaza plants (P=0.16).

Table 5.19: *S. aureus* distributed of central tendency measures according to plant license and location.

Item	Sample No.	*S. aureus*			
		Min.	Max.	Mean	Std.
Total product	173	0	3e4	635.8	2689.6
License Plant	124	0	3e4	716.1	3091.5
Unlicensed Plant	49	0	6e3	432.7	1171.4
New Gaza suburb	128	0	3e4	803.9	3095.6
Old Gaza suburb	45	0	3e3	157.8	551.6

5.2.2.4 Distribution of compliance *S. aureus* samples according to plant license and location:

Distribution of compliance *S. aureus* samples according to plant license and location is given in Table 5.20. Out of of 124, 104 (83.9%) cake samples produced by licensed plants were compliance with *S. aureus* limits whereas 40 of 49 (81.6%) samples produced by unlicensed plants were compliance with *S. aureus* limits. The difference between the two groups was not statistically significant (P=0.72). Concerning plant location, the number of samples showed compliance from the new and old Gaza plants were 104 of 128 (81.2%) and 40 of 45 (88.9%), respectively. However, the difference between the two groups was not statistically significant (P=0.23).

Table 5.20: Distribution of compliance *S. aureus* samples according to plant license and location.

Collected samples from	Sample No.	≤10 e2 Compliance	> 10 e2 incompliance	Odds Ratio	P-value
		No. (%)	No. (%)	Value (95% CI)	
License plant	124	104 (83.9)	20 (16.1)	1.170 (0.492-2.8)	0.72
Unlicensed plant	49	40 (81.6)	9(18.4)		
New Gaza suburb	128	104 (81.2)	24 (18.8)	1.846 (0.659-5.2)	0.23
Old Gaza suburb	45	40 (88.9)	5(11.1)		

5.2.3 Total *coliform*

5.2.3.1 Group frequency of total *coliform*:

Table 5.21 shows groups frequency of total *coliform* per gm for all collected samples (173). A total of 94 (54.3%) samples were contaminated. The highest number of tested samples 35 (20.2%) was found to have *coliform* range of >10 e2 to 10 e3. According to the *coliform* limit (*coliform* <10e3), 55 (31.8%) tested cake samples are considered unacceptable.

Table 5.21: Groups frequency of *Coliform* (n=173).

***Coliform* range**	**Sample**	
	No.	**%**
0	79	45.7
11-100	04	02.3
101 -1000	35	20.2
***1001 -10000**	33	19.1
10001 -100000	20	11.6
100001>	02	01.2
total	173	100.0

***=** the number considered more than the limit (the samples unaccepted)

5.2.3.2 Group frequency of *coliform* according to plant license and location:

Group frequency of *coliform* according to plant license and location is illustrated in Table 5.22. The numbers of collected cake samples from licensed and unlicensed plants were 124 and 49, respectively. A total of 64 (51.6%) and 30 (61.2%) samples from licensed and unlicensed plants were found to be contaminated. The highest number of tested samples 23 (18.5%) from licensed plant was found to have *Coliform* range of >10 e2 to 10 e4 whereas those from unlicensed plant 12 (24.5%) was found to have *coliform* range of >10 e2 to 10 e3. According to the *coliform* limit, 37 (29.8%) and 18 (36.7%) cake samples from licensed and unlicensed plants were unacceptable. Concerning plant location, the number of collected cake samples from the new and the old Gaza plants were 128 and 45, respectively. A total of 79 (61.7%) and 15 (33.3%) samples from the new and old Gaza plants were found to be contaminated. The highest number of tested samples 29 (22.7%) from the new Gaza plant was found to have *coliform* range of >10 e3 to 10 e4 whereas those from the old Gaza plant 9 (20.0) was found to have *coliform* range of >10 e2 to 10 e3. According to the *coliform* limit, 50 (39.1%) and 5 (11.1%) cake samples from the new and old Gaza plants were unacceptable.

Table 5.22: Groups frequency of *coliform* according plant and location.

***Coliform* range**	**License Plant**	**Unlicensed Plant**	**New Gaza**	**Old Gaza**
	Sample No. (%)	**Sample No. (%)**	**Sample No. (%)**	**Sample No. (%)**
0	60 (48.4)	19 (38.8)	49 (38.8)	30 (66.7)
11-10e2	4 (3.2)	0 (0.0)	3 (2.3)	1 (2.2)
101-10e3	23 (18.5)	12 (24.5)	26 (20.3)	9 (20.0)
***1001-10e4**	23 (18.5)	10 (20.4)	29 (22.7)	4 (8.9)
10001-10e5	12 (9.7)	8 (16.3)	19 (14.8)	1 (2.2)
100001-10e6	2 (1.6)	0 (0.0)	2 (1.6)	0 (0.0)
Total	124	49	128	45

***=** the number considered more than the limit (the samples unaccepted)

5.2.3.3 *Coliform* distributed of central tendency measures according to plant license and location:

Table 5.23 presents *coliform* distributed of central tendency measures according to plant license and location. The mean value of *coliform* for all collected samples (n=173) was 1.01e4±33443.7 (range 0 to 3e5). Sample tested from licensed plants (n=124) had mean *Coliform* of 9612.1±36231.5 (range 0 to 3e5) whereas those from unlicensed plants (n=49) had mean *Coliform* of 11391.8±25332.5 (range 0 to 9e4). Concerning plant location, the mean *coliform* in sample collected from new Gaza plants (n=128) was 13408.6±38336.1 (range 0 to 3e5) whereas that of samples collected from old Gaza plants (n=45) was

751.1±3008.6 (range 0 to 2e4). One sample T test revealed that the mean *coliform* of all samples (1.01e4) was higher than the *coliform* limit (10e3) and the difference between the two means was statistically significant (P=0.00). Also, *coliform* mean of the samples collected from licensed plants exceeded that of *coliform* limit, and the difference was statistically significant (P=0.00). On the other hand, *Coliform* mean of the samples collected from unlicensed plants was significantly higher than *coliform* limit (P=0.00). T sample test independent showed that the mean *coliform* of cake samples collected from unlicensed plant was higher than that of samples collected from licensed plants (P=0.75). Also, *coliform* of cake samples collected from the new Gaza plant was higher than the limit but the difference was statistically significant (P=0.00). The samples collected from the old Gaza plants was lower than the limit but the difference was not statistically significant (P=0.58).

Table 5.23: *Coliform* distributed of central tendency measures according to plant license and location.

Item	Sample No.	*Coliform*			
		Min.	Max.	Mean	Std.
Total collected	173	0	3e5	1.01e4	33443.7
License Plant	124	0	3e5	9612.1	32631.5
Unlicensed Plant	49	0	9e4	11391.8	25332.5
New Gaza suburb	128	0	3e5	13408.6	38336.1
Old Gaza suburb	45	0	2e4	751.1	3008.6

5.2.3.4 Distribution of compliance *coliform* samples according to plant license and location:

Distribution of compliance *coliform* samples according to plant license and location is given in Table 5.24. Out of 124, 87 (70.2%) cake samples produced by licensed plants were compliance with *coliform* limits whereas 40 of 49 (81.6%) samples produced by unlicensed plants were compliance with *coliform* limits. The difference between the two groups was not statistically significant (p=0.38). Concerning plant location, the number of samples shows compliance from the new and old Gaza plants were 78 of 128 (60.9%) and 40 of 45 (88.9%), respectively. However, the difference between the two groups was statistically significant (P=0.001).

Table 5.24: Distribution of compliance *coliform* samples according to plant license and location.

Collected samples from	Sample No.	≤10 e3 Compliance	> 10 e3 incompliance	Odds Ratio	P-value
		No. (%)	No. (%)	Value (95% CI)	
License plant	124	87 (70.2)	37 (29.8)	1.365 (0.680-2.7)	0.38
Unlicensed plant	49	40 (81.6)	9 (18.4)		
New Gaza suburb	128	78 (60.9)	50 (39.1)	5.128 (1.896-13.9)	0.001
Old Gaza suburb	45	40 (88.9)	5 (11.1)		

5.2.4 *Escherichia coli*:

5.2.4.1 Group frequency of *E.coli*:

Table 5.25 shows group frequency of *E.coli* per gm in all collected samples (173). A total of 29 (16.8%) samples were contaminated. The highest number of tested samples 15 (8.7%) was found to have *E.coli* range of >10 e2 to 10 e3. According to the *E.coli* limit (*E.coli* above 0 cell/g), 29 (16.8%) cake samples are considered unacceptable.

Table5.25: Group frequency of *E.coli* (n=173).

E.coli range	Sample	
	No.	%
0	144	83.2
***11-100**	3	1.7
101 -1000	15	8.7
1001-10000	8	4.6
10001>	3	1.7

***=** the number considered more than the limit (the samples unaccepted)

5.2.4.2 Group frequency of *E.coli* according to plant license and location:

Group frequency of *E.coli* according to plant license and location is illustrated in Table 5.26. The numbers of collected cake samples from licensed and unlicensed plants were 124 and 49 respectively. A total of 20 (16.1%) and 9 (18.4%) samples from licensed and unlicensed plants were found to be contaminated. The highest number of tested samples 10 (8.1%) was found to have *E.coli* range of >10 e2 to 10 e3. According to the *E.coli* limit (E.coli=0), 20(16.1%) cake samples are considered unacceptable. Whereas those from unlicensed plant 5 (10.2%) was found to have *E.coli* range of >10 e2 to 10 e3 According to the *E.coli* limit (E.coli=0), 9(18.4%) cake samples are considered unacceptable. Concerning plant location, the number of collected cake samples from the new and old Gaza plants were 128 and 45, respectively. A total of 26 (20.3%) and 3 (6.7%) samples from the new and old Gaza plants were found to be contaminated. The highest number of tested samples 12 (9.4%) from the new Gaza plant was found to have *E.coli* range of >10 e2 to 10 e3 whereas those from old Gaza plant 3 (6.7%) was found to have *E.coli* range of >10 e2 to 10 e3. According to the *E.coli* limit, 26 (20.3%) and 3 (6.7%) cake samples from new and old Gaza plants were unacceptable.

Table 5.26: Group frequency *E.coli* according plant and location.

***E.coli* range**	**License Plant**	**Unlicensed Plant**	**New Gaza**	**Old Gaza**
	Sample No. (%)	**Sample No. (%)**	**Sample No. (%)**	**Sample No. (%)**
0	104 (83.9)	40 (81.6)	102 (79.7)	42 (93.3)
***1-10e2**	3 (2.4)	0 (0.0)	3 (2.3)	0 (0.0)
101-10e3	10 (8.1)	5 (10.2)	12 (9.4)	3 (6.7)
1001-10e4	5 (4)	3 (6.1)	8 (6.2)	0 (0.0)
10001-10e5	2 (1.6)	1 (2.0)	3 (2.3)	0 (0.0)
Total	124 (100)	49 (100)	128 (100)	45 (100)

***=** the number considered more than the limit (the samples unaccepted)

5.2.4.3 *E.coli* distributed of central tendency measures according to plant license and location:

Table 5.27 presents *E.coli* distributed of central tendency measures according to plant license and location. The mean value of *E.coli* for all collected samples (n=173) was 1157.8±8316.1 (range 0 to 1e5). Sample tested from licensed plants (n=124) had mean *E.coli* of 675±4044.5 (range 0 to 4e4) whereas those from unlicensed plants (n=49) had mean *E.coli* of 2379.6±14274.8 (range 0 to 10e5). Concerning plant location, the mean *E.coli* in sample collected from the new Gaza plants (n=128) was 1553.9±9646 (range 0 to 10e5) whereas that of samples collected from the old Gaza plants (n=45) was 31.1±153.5 (range 0 to 10e3). One sample T test revealed that the mean *E.coli* of all samples (1157.8) was higher than the *E.coli* limit (0). However, the difference between the two means was not statistically significant (P=0.069). Also, *E.coli* mean of the samples collected from licensed plants exceeded that of *E.coli* limit, but the difference was not statistically significant (P=0.06). On the other hand, *E.coli* mean of the samples collected from unlicensed plants was higher than *E.coli* limit but the difference was not significantly (P=0.24). T sample test independent showed that the mean *E.coli* of cake samples collected from licensed plant was lower than that of samples collected from unlicensed plants (P=0.22). Also, the mean of *E.coli* cake samples collected from the new Gaza plant was higher than that of samples collected from the old Gaza plants (P=0.29).

Table 5.27: *E.coli* distributed of central tendency measures according to plant license and location.

Item	Sample No.	*E.coli*			
		Min.	Max.	Mean	Std.
Total collected	173	0	1e5	1157e8	8316.1
License Plant	124	0	40000	675	4044.6
Unlicensed Plant	49	0	100000	2379.6	14274.8
New Gaza suburb	128	0	100000	1553.9	9646
Old Gaza suburb	45	0	1000	31.1	153.5

5.2.4.4 Distribution of compliance *E.coli* samples according to plant license and location:

Distribution of compliance *E.coli* samples according to plant license and location is given in Table 5.28. Out of 124, 104 (83.9%) cake samples produced by licensed plants were compliance with *E.coli* limits whereas 40 of 49 (81.6%) samples produced by unlicensed plants were compliance with *E.coli* limits. The differences between the two groups were not statistically significant (P=0.72). Concerning plant location, the number of samples showed compliance from the new and old Gaza plants were 102 of 128 (79.7%) and 42 of 45 (93.3%), respectively. However, the differences between the two groups were statistically significant (P=0.03).

Table 5.28: Distribution of compliance *E.coli* samples according to plant license and location.

Collected samples from	Sample No.	=0 Compliance	> 0 incompliance	Odds Ratio	P-value
		No. (%)	No. (%)	Value (95% CI)	
License plant	124	104 (83.9)	20 (16.1)	1.170 (0.492-2.8)	0.72
Unlicensed plant	49	40 (81.6)	9(18.4)		
New Gaza suburb	128	102 (79.7)	26 (20.3)	3.569 (1.025-12.4)	0.03
Old Gaza suburb	45	42 (93.3)	3 (6.7)		

5.2.5 *Molds*:

5.2.5.1 Group frequency of *Molds*:

Table 5.29 shows group frequency of *molds* per gm in all collected samples (173). A total of 20 (11.6%) samples were contaminated. The highest number of contaminated tested samples 15 (8.8%) was found to have *molds* range of >10 e2 to 10 e3. Our finding agree with (Fustier, et al, 1998) illustrated that *molds* were isolated from commercial cakes and were identified as *Aspergillus sydowii, Aspergillus ochraceus, Penicillium funiculosum,* and *Eurotium herbariorum.*

Table 5.29: Group frequency of *mold*.

Range of counts *mold*	*mold*	
	No.	%
0	153	88.4
11-100	004	02.3
101 -1000	015	08.7
1001>	001	00.6

5.2.5.2 Group frequency of *Molds* according plant and location:

Group frequency of *molds* count according to the plant license and location is illustrated in Table 5.30. The numbers of collected cake samples from licensed and unlicensed plants were 124 and 49, respectively. A total of 19 (15.3%) and 1 (2.04%) samples from licensed and unlicensed plants were found to be contaminated. The highest number of tested samples 14 (11.3%) from licensed plant was found to have *molds* range of >10 e2 to 10 e3 whereas those from unlicensed plant 1 (2.04%) was found to have *molds* range of >10 e2 to 10 e3. Concerning plant location, the number of collected cake samples from the new and old Gaza plants were 128 and 45, respectively. A total of 15 (11.7%) and 5 (11.1%) samples from the new and old Gaza plants were found to be contaminated. The highest number of tested samples 12 (9.4%) from the new Gaza plant was found to have *molds* range of >10 e2 to 10 e3 whereas those from the old Gaza plant 3 (6.7%) was found to have *molds* range of >10 e2 to 10 e3.

Table 5.30: Group frequency of *Mold* according plant and location.

mold range	License Plant	Unlicensed Plant	New Gaza	Old Gaza
	Sample No. (%)	Sample No. (%)	Sample No. (%)	Sample No. (%)
0	105 (84.7)	48 (98)	113 (88.3)	40 (88.9)
11-10e2	4 (3.2)	0 (0.0)	2 (1.6)	2 (4.4)
101-10e3	14 (11.3)	1 (2.0)	12 (9.4)	3 (6.7)
1001-10e4	1 (0.8)	0 (0.0)	1 (0.8)	0 (0.0)
Total	124 (100)	49 (100)	128 (100)	45 (100)

5.2.5.3 *Mold* distributed of central tendency measures according to license and location plant:

Table 5.31 presents molds distributed of central tendency measures according to plant license and location. The mean value of *molds* for all collected samples (n=173) was 92.49±769 (range 0 to 1e4). Sample tested from licensed plants (n=124) had mean *molds* of 121±903.3 (range 0 to 1e4) whereas those from unlicensed plants (n=49) had mean *molds* of 20.4±142.9 (range 0 to 1e3). Concerning plant location, the mean *molds* in sample collected from the new Gaza plants (n=128) was 118±892.7 (range 0 to 1e4) whereas that of samples collected from the old Gaza plants (n=45) was 20±62.5 (range 0 to 3e2). When using T sample test to compare between the mean of *mold* from license and unlicensed plant, it was found that the mean of license plant higher than the mean of unlicensed plant, but the differences were not statistically significant (P=0.44), also comparing between the mean of *mold* from the new and old Gaza plant, it was found that the mean of new Gaza plant higher than the mean of the old Gaza plant, but the differences were not statistically significant (P=0.46).

Table 5.31: *Mold* distributed of central tendency measures according to license and location plant.

Product Produced in	No. of tested samples	*mold*			
		Min.	Max.	Mean	Std.
Total product	173	0	1e4	92.5	769
License Plant	124	0	10000	121	903.3
Unlicensed Plant	49	0	1000	20.4	142.9
New Gaza suburb	128	0	10000	118	892.7
Old Gaza suburb	45	0	300	20	62.5

5.2.6 *Oidium lacts*:

5.2.6.1 Group frequency of *O.lacts*:

Table 5.32 shows group frequency of *O.lacts* per gm in all collected samples (173). A total of 15 (8.7%) samples were contaminated. The highest number of contaminated tested samples 11 (6.4%) was found to have *O.lacts* range of >10 e2 to 10 e3.

Table 5.32: Group frequency of *O.lacts*.

Range of counts *O.lacts*	*O.lacts*	
	No.	%
0	158	91.3
11-100	001	00.6
101 -1000	011	06.4
1001>	003	01.7

5.2.6.2 Group frequency of *O.lacts* according plant and location:

Group frequency of *O.lacts* according to the plant license and location is illustrated in Table 5.33. The numbers of collected cake samples from licensed and unlicensed plants were 124 and 49, respectively. A total of 8 (6.5%) and 7 (14.3%) samples from licensed and unlicensed plants were found to be contaminated. The highest number of tested samples 6 (4.8%) from licensed plant was found to have *O.lacts* range of >10 e2 to 10 e3 whereas those from unlicensed plant 5 (10.2%) was found to have *O.lacts* range of >10 e2 to 10 e3. Concerning plant location, the number of collected cake samples from the new and old Gaza plants were 128 and 45, respectively. A total of 9 (7.03%) and 6(13.3%) samples from new and old Gaza plants were found to be contaminated. The highest number of tested samples 6 (4.7%) from the new Gaza plant was found to have *O.lacts* range of >10 e2 to 10 e3 whereas those from the old Gaza plant 5 (11.1%) was found to have *O.lacts* range of >10 e2 to 10 e3.

Table 5.33: Group frequency of *O.lacts* according plant and location.

O.lacts range	License Plant	Unlicensed Plant	New Gaza suburb	Old Gaza suburb
	Sample No. (%)	Sample No. (%)	Sample No. (%)	Sample No. (%)
0	116 (93.5)	42 (85.7)	119 (39.0)	39 (86.7)
11-10e2	1 (0.8)	0 (00.0)	1 (0.8)	0 (00.0)
101-10e3	6 (4.8)	5 (10.2)	6 (4.7)	5 (11.1)
1001-10e4	1 (0.8)	2 (4.1)	2 (1.6)	1(2.2)
Total	124 (100)	49 (100)	128 (100)	45 (100)

5.2.6.3 *O.lacts* distributed of central tendency measures according to license and location plant:

Table 5.34 presents *O.lacts* distributed of central tendency measures according to plant license and location. The mean value of *O.lacts* for all collected samples (n=173) was 135.3±844.3 (range 0 to 1e4). Sample tested from licensed plants (n=124) had mean *O.lacts* of 57.3±377.02 (range 0 to 4e3) whereas those from unlicensed plants (n=49) had mean *O.lacts* of 332.7±1461.1 (range 0 to 1e4). Concerning plant location, the mean *O.lacts* in sample collected from new Gaza plants (n=128) was 143.8±959.6 (range 0 to 1e4) whereas that of samples collected from old Gaza plants (n=45) was 111.1±357.5 (range 0 to 2e3). When using T sample test to compare between the mean of *O.lacts* from license and unlicensed plant, it was found that the mean of unlicensed higher than the mean of licensed plant, but the differences were statistically significant (P=0.05), also comparing between the mean of *O.lacts* from new Gaza plant and old Gaza plant, it was found the mean of new Gaza plant higher than the mean of old Gaza plant, but the differences were not statistically significant (P=0.82).

Table 5.34: *O.lacts* distributed of central tendency measures according to license and location plant.

Product Produced in	No. of tested samples	*O.lacts.*			
		Min.	Max.	Mean	Std.
Total product	173	0	1e4	135.3	844.3
License Plant	124	0	4000	57.3	377.0
Unlicensed Plant	49	0	10000	332.7	1461.1
New Gaza suburb	128	0	10000	143.8	959.6
Old Gaza suburb	45	0	2000	111.1	357.5

5.2.7 The relationship between the presences of microbes:

To fined if there was relationship between the presence of T.B.C and the *S. aureus, Coliform, E.coli, mold* and *O.lacts* was found the association strong relationship, significant for all (P=0.0). A relationship between *S.aureus* and the others; *Coliform, E.coli, mold* and *O.lacts,* the relationship was found strong statistically significant (P=0.0) for all, but only with *mold* was found not statistically significant (P=1.00). A relationship between *Coliform* and the others; *E.coli, mold* and *O.lacts,* the relationship was found strong statistically significant (P=0.0) for all, but only with *mold* was found not statistically significant (P=0.37). A relationship between *E.coli* and the others; *mold* and *O.lacts,* the relationship was found strong statistically significant (P=0.0) for all. A relationship between *mold* and *O.lacts*, the relationship was found strong statistically significant (P=0.0).

The relationship between the presence of all microbes in cake samples found significant where as their condition to live nearly the same and the source of recontamination also the same from workers and the ingredient that not cooked during the cake decoration but the mold was not significant where as mold recontaminated from environment of the plant and ingredient.

5.2.8 Mean of microbes according to season:

Table 5.35 bellow shows the mean of microbes, with 81 samples were tested in winter, the mean of TBC, *S.aureus*, *Coliform*, *E.coli*, *mold* and *O.lacts*; 4.94e4, 256.8, 4198.8, 128.4, 55.6 and 112.4 respectively, in addition 92 samples were tested in summer, and the means were 1.47e5, 969.6, 1.53e4 , 2064.1, 125.0 and 155.4 respectively. from the table notes that all the means of microbes were higher in summer than the microbial means in winter. The comparison between the means, using T. sample test, the difference between the means in *TBC* was statistically significant (P=0.04) , the difference between the means in *S.aureus* was not statistically significant (P=0.08), the difference between the means in *Coliform* was statistically significant (P=0.02), the difference between the means in *E.coli* was not statistically significant (P=0.12), the difference between the means in *mold* was not statistically significant (P=0.55), and the difference between the means in *O.lacts* was not statistically significant (P=0.73). The difference between the means and the higher in summer related to high temperature in summer than winter which suitable temperature for microbial growth.

Table 5.35: distribution the mean of microbes according to seasons.

Microbes name	winter		Summer		P value
	No. of samples	Mean	No. of samples	Mean	
TBC	81	4.94e4	92	1.47e5	0.04
S. aureus		256.8		969.57	0.08
Coliform		4198.8		1.53e4	0.02
E.coli		128.4		2064.1	0.12
mold		55.6		125.0	0.55
O.lacts		112.4		155.4	0.73

Chapter 6

6.1 Conclusion

6.1.1 Questionnaire results

1- Almost all workers were males. The mean age of the study population was 29.9 years and well educated.

2- A total of 70 (77.8%) workers had medical examination. Regarding workers, infection, 11 (12.2%) workers stayed at work whereas 79 (87.8%) stayed at home.

3- The majority of workers have knowledge about the microbe and the source of contamination.

4- Workers mentioned that pest had caused problems in the plant while, (87.8%) cake workers stated that pest control is applied in the plant.

5-Concerning disinfections of tools and equipments, 54 (60.0%) workers made disinfection.

6- Sixty two (68.9%) stored final product separately in refrigerator at5-10^{o}C.

7- Sixty (66.7%) and 70 (77.8%) workers agreed to increase the plant area and the need for more training.

8- Most of the plants are licensed and mainly inspected by the Ministry of Health.
9- Municipal water is the main source of water in the plant and plastic water tanks were commonly used for storing water.

6.1.2 Microbial results

1- Most of the samples (85.5%) were contaminated with *Total Bacteria Count* but according to the *TBC* limit (TBC<10e5), only 24 (29.2%) were unacceptable.

2- (17.3%) samples were contaminated with *S. aureus* most of them were unacceptable according to the *S.Aureus* limit (*S.aureus* <10e2).

3- *Coliform*: (54.3%) samples were contaminated but according to the *coliform* limit (*coliform* <10e3), (31.8%) cake samples are considered unacceptable.

4- *E.coli:* 29 (16.8%) samples were contaminated, and according to the *E.coli* limit (*E.coli* =0), all of them unacceptable.

5- *Molds:* 20 (11.6%) samples were contaminated. The mean value of *molds* for all collected samples (n=173) was 93cell/gr. (rang 0 to 1e4).

6- *O.lacts:* 15 (8.7%) samples were contaminated. The mean value of *O.lacts* for all collected samples (n=173) was 135cell/gr (rang 0 to 1e4).

7- the means of microbes were higher in summer than the microbial means in winter for tested samples.

Chapter 6

6.2 Recommendations

1. The workers should do medical examination before getting their job in the cake plant.

2. The owner of the plant should not allow the sick workers to handle food until recovery.

3. All the plants should be licensed.

4. Palestinian cake standard should be established.

5. Emphasis on implementing HACCP in cake plant.

6. Workers should be trained in the filed of food safety before getting the work, training the workers should include GHP as well as microbiology course.

7. Wearing special uniform is necessary during the work.

8. Putting a poster guides and facilities for hand washing.

10. Raw material must be suitably processed, stored and handled before and during manufacturing.

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Annex 1

Palestinian National Authority
Ministry of Health
Helsinki Committee

السلطة الوطنية الفلسطينية
وزارة الصحة
لجنة هلسنكي

Date: 1/7/2008

التاريخ: ٢٠٠٨/٧/١

Name: Bashir Mourad

الاسم: بشير مراد

I would like to inform you that the committee has discussed your application about:

نفيدكم علماً بأن اللجنة قد ناقشت مقترح دراستكم حول:-

Food Hygiene and Safety Among Cake Bakeries in Gaza Governorate

In its meeting on July 2008
and decided the Following:-
To approve the above mention research study.

و ذلك في جلستها المنعقدة لشهر يوليو ٢٠٠٨
و قد قررت ما يلي:-
الموافقة على البحث المذكور عاليه.

Ministry of Health Signature Halsinki Committee توقيع

Ministry of Health Member عضو Halsinki Committee

Member

Chairperson

Conditions:-

- Valid for 2 years from the date of approval to start.
- It is necessary to notify the committee in any change in the admitted study protocol,
- The committee appreciate receiving one copy of your final research when it is completed.

Gaza Etwam – Telefax 972-7-2878166

Annex 2

٢٠٠٨-٢-١٩

السيد مدير عام الرعاية الصحية الأولية حفظه الله

السلام عليكم ورحمة الله وبركاته

الموضوع / السماح بعمل الفحوصات الميكروبيولجيه بمختبر الصحة العامة

أفيدكم علماً بأن عنوان رسالتي في دراسة ماجستير صحة البيئة هي (معرفة وسلوك وممارسات العاملين في مجال إنتاج وبيع الجاتوه في محافظة غزة)

(Knowledge, attitude and practice of cake workers toward microbial contamination in Gaza governorate)

لذا أرجو من سيادتكم الموافقة بالسماح لي بعمل الفحوصات الميكروبيولجيه بمختبر الصحة العامة لعينات الجاتوه التي سوف أقوم بجمعها من محلات البيع والإنتاج وذلك لدراسة المتغيرات والعلاقات المتوقعة بخصوص هذه الرسالة إضافة إلى معرفة أنواع البكتريا الموجودة في المنتج النهائي ومقارنة الميكروبات الملوثة للمنتج مع المواصفات الفلسطينية علما بأن الفحوصات الميكروبيولجيه التي سوف يتم عملها هي نفس الفحوصات التي يتم عملها لعينات الجاتوه التي يتم جمعها من خلال قسم مراقبة الأغذية الروتينية.

هذا للعلم ولكم جزيل الشكر والعرفان واقبلوا فائق الاحترام والتقدير

مقدمه لسيادتكم

الطالب/ بشير أحمد مراد

الأخ / رئيس قسم الميكروبيولوجي

الإخوة / أ / الاستقبال لعينات

للتعاون وعمل اللازم

حسب الأصول

١٢/٢/ ٢٠٠٨

حسب الأصول

Formed Consent (Arabic Version)

الرقم: -------------

التاريخ: /   /2008

عنوان البحث
صحة وسلامة الجاتوه في مصانع إنتاجها بمحافظة غزة

الأخ الكريم:

صاحب/ مدير/ العامل، لطفاً أود أن أخبركم أنه وقع عليكم الاختيار لتكونوا جزء من دراستي البحثية بعنوان "صحة وسلامة الكيك في مصانع إنتاجها بمحافظة غزة" كجزء من متطلب برنامج ماجستير الذي تديره جامعة القدس- برنامج الصحة العامة. منشأتكم من ضمن التي وقع عليها الاختيار كمصدر للمعلومات اللازمة لتعبئة الاستبانة ولعينات الجاتوه التي سيتم فحصها مخبرياً.

وأعلمكم بأن جميع البيانات التي سيتم الحصول عليها هي خاصة بالبحث فقط وستكون في سرية كاملة وإن مشاركتكم في هذا البحث مهمة وأي معلومات معطاة منكم لن تلحق بكم الضرر أبداً.

جزيل الشكر لحسن تعاونكم

الباحث
بشير أحمد مراد
غزة – الدرج عيادة الصوراني جوال/0599889953

....

إقرار بالموافقة

التاريخ: /   / 2008

أنا الموقع أدناه/ .... بصفتي مالك/ مدير/ عامل لإنتاج الجاتوه بمحافظة غزه/ .... قد تفهمت جيداً أهداف هذا البحث وكل المتطلبات لتعبئة الاستبيان.

وأنني أعلم أن معلومات البحث ستكون محل السرية التامة ولن يتم استعمالها إلا بهدف المعرفة العلمية البحثية لغرض التخطيط الصحي والاقتصادي.

التوقيع

Formed Consent (English Version)

Number:…………
Date: /   /2008

Food Hygiene and Safety Among Cake Bakeries in Gaza Governorate

Dear Owner/ Director/ Worker,

Kindly I would like to inform you that you have been selected to be part of my research study " Food Hygiene and Safety Among Cake Bakeries in Gaza Governorate" as part of requirement for master degree Program organized by Al-Quds University- public health program. Your facility has been thoroughly selected as a source of data by filling well and comprehensive a questionnaire for that purpose.
All the information given from your side is top confidential and will be used to asses Food Hygiene and Safety Among Cake Bakeries. Your participation is greatly appreciated and no information given would be used against you whatsoever.

Thanking you in advance for your cooperation.
Best Regards.

The researcher
Bashir A. Mourad

…………………………………………………………..

Date: /   / 2008
I, the undersigned,…………………………………………in my capacity as Owner/ Director/ Worker for cake making plant in Gaza Governorate, completely understands the objectives of this research and has the full desire to fill in the following questionnaire.
As well as, I do realize that all information given will be top confidential and will be used for research purposes and health and economic planning.

Signature

Annex 4

الرقم الاستبيان:..............

التاريخ: ....

البيانات الشخصية

1) **العمر**:..................

2) **الجنس** : 1 ذكر 2 أنثى

3) **عنوان السكن:**

1 الشجاعية 2 الدرج 3 التفاح 4 الزيتون 5 الصبرة 6 الرمال 7 الشاطئ 8 الشيخ رضوان 9 أخرى/ حدد

4) **عدد سنوات التعليم:** ....

5) **عدد سنوات الخبرة في مجال تصنيع الجاتوه:**...............

6) **مهمتك في العمل:** 1 مالك 2 عامل فني

7) **هل أخذت دورة تدريبية في مجال إنتاج الجاتوه والممارسات الصحية الجيدة؟** 1 نعم 2 لا

صحة العاملين

أ- الحالة الصحية:

8) **هل تجري فحص طبي دوري؟** 1 نعم 2 لا

9) **هل طلب منك أخذ علاج لما أظهرته النتيجة؟** 1 نعم 2 لا

10) **في حالة وجود عندك حرارة ، يرقان، إسهال، قيئ، إفرازات من الأذن، العين، الأنف، فهل أنت؟**

1 تبقى في العمل 2 تغير دورك في العمل 3 تبقى في البيت حتى الشفاء

11) **في حالة إصابتك بجروح أو دمامل؟** 1 تبقى في البيت 2 أضمدها بغطاء آمن ضد الماء

ب- النظافة الشخصية:

12) **هل تقوم بتقليم أظافرك باستمرار؟** 1 نعم 2 لا .

13) **هل تغسل يدك بالماء والصابون خلال العمل؟** 1 نعم 2 لا

14) **هل تغسل يدك بالماء والصابون بعد الخروج من المرحاض؟** 1 نعم 2 لا

15) **في حالة التدخين هل تغسل يدك بالماء والصابون بعد التدخين؟** 1 نعم 2 لا 3 لا يوجد تدخين

16) **هل تغسل يدك بالماء والصابون بعد ملامسة الملابس أو الشعر أو الجلد؟** 1 نعم 2 لا

17) **هل تغسل يدك بالماء والصابون بعد تغيير المكان في خطوات العمل؟** 1 نعم 2 لا

18) **هل تغسل يدك بالماء والصابون بعد الأكل؟** 1 نعم 2 لا

19) **هل تغسل يدك بالماء والصابون بعد تفريغ أو ترحيل النفايات؟** 1 نعم 2 لا

20) **هل تغسل يدك بالماء والصابون عند بدء العمل؟** 1 نعم 2 لا

21) **هل تغسل يدك بالماء والصابون عند التعامل بالمواد الخام؟** 1 نعم 2 لا

22) **هل تستخدم مواد مطهرة بعد غسيل يديك؟** 1 نعم 2 لا

23) **هل ترتدي زى خاص في العمل؟** 1 نعم 2 لا

24) **هل تستبدل ملابس العمل؟** 1 يومياً 2 مرة كل يومين 3 مرة كل ثلاث أيام 4 مرة أسبوعياً 5 عندما تتسخ.

25) **هل تحفظ ملابس العمل في مكان خاص؟** 1 نعم 2 لا

26) **هل تستخدم القفازات أثناء تزيين المنتج النهائي؟** 1 نعم 2 لا

27) **إذا كانت الإجابة بنعم، هل هي؟** 1 استخدام لمرة واحدة 2 استخدام لعدة مرات

ج-السلوك الشخصي:

28) **هل تلبس خواتم أو مجوهرات في يديك أثناء العمل؟** 1 نعم 2 لا

29) **هل تدخن، تبصق، تتناول العلكة، تأكل أو تجلس على طاولات التصنيع خلال العمل؟** 1 نعم 2 لا

30) **هل تغطي الفم والأنف أثناء العطس أو السعال؟** 1 نعم 2 لا

31) **هل تغسل يديك بعد العطس ، السعال أو تغيير القفازات؟** 1 نعم 2 لا

الخلفية العلمية

1-المعرفة حول التلوث الميكروبي للغذاء

32) **هل الميكروب؟** 1 **بكتيريا** 2 **فطر** 3 **خمائر** 4 **فيروس** 5 **جميع ما سبق** 6 **لا أعرف**

33) **هل تعتقد أن الميكروب** 1 **مفيد** 2 **ضار** 3 **كل ما سبق** 4 **لا أعرف.**

34) **هل تعرف أن الميكروب يلوث الطعام؟** 1 نعم 2 لا

35) **مصدر التلوث يأتي من عدم نظافة** 1 العمال 2 الأدوات 3 المواد الخام 4 المكان 5 جميع ما سبق

36) **هل تعتقد أن الميكروب يفسد الطعام؟** 1 نعم 2 لا

37) **هل سمعت عن تسمم الغذائي نتيجة لتناول الجاتوه؟** 1 نعم 2 لا 3 لا أدري

38) **هل حصل لديك تسمم غذائي من أكل الجاتوه؟** 1 نعم 2 لا 3 لا أدري

39) **هل تعرف أن الميكروبات تنمو و تتكاثر؟** 1 نعم 2 لا

40) **إذا كانت الإجابة بنعم، هل يحتاج الميكروب إلى؟**

1 درجة حرارة دافئة 2 غذاء غير حامض 3 بقايا غذاء ورطوبة مناسبة 4 كل ما سبق 5 لا أعرف

2-الممارسات

2-1 المكونات (المواد الخام)

41) **هل تشتري المكونات من باعة معتمدين؟** 1 نعم 2 لا 3 الاثنين معاً

42) **إذا كانت الإجابة بنعم، هل يتم فحص المكونات قبل الاستلام طبقاً للمواصفات؟** 1 نعم 2 لا

43) **هل يتم تخزين المكونات في مكان خاص؟** 1 نعم 2 لا

44) **هل تتبع نظام استخدام المكونات أولاً بأول حسب تخزينها؟** 1 نعم 2 لا

45) **كيف تتعامل مع المكونات الغير مقبولة؟** 1 أعيدها للمصدر 2 أتلفها 3 استخدمها

2-2 مكافحة الآفات:

46) **هل سببت الآفات أي مشكلة في المصنع؟** 1 نعم 2 لا

47) **هل لديك أي نظام للوقاية من الآفات؟** 1 نعم 2 لا

48) **إذا كان نعم :** 1 شبك نملي للشبابيك 2 إغلاق الأبواب جيدا 3 الحفاظ على إغلاق الفتحات والشقوق 4 نظافة المكان 5 كل ما سبق

49)في حال وجود حشرات المكافحة تكون:

1 ميكانيكي 2 كيميائي 3 كهربائي 4 ميكانيكي& كيميائي 5 ميكانيكي & كهربائي 6 كيميائي& كهربائي

7 ميكانيكي & كيميائي & كهربائي

50)في حال وجود جرذان المكافحة تكون:

1 ميكانيكي 2 كيميائي 3 كهربائي 4 ميكانيكي& كيميائي 5 ميكانيكي & كهربائي 6 كيميائي& كهربائي

7 ميكانيكي & كيميائي & كهربائي

51)القائمين على عملية المكافحة 1 عمال المصنع 2 خبير 3 آخرون / حدد

52)عند استخدام كيماويات في المكافحة ،هل يتم تخزينها في مكان خاص، بعيداً آمناً عن خط الإنتاج؟ 1 نعم 2 لا

2-3-المنظفات والمطهرات

53)متى يتم تنظف كل الأدوات والمعدات المستخدمة؟

1 عندما تتسخ 2 عند الانتهاء من العمل 3 عند تغيير خطوات العمل 4 كل ما سبق

54)كيف تزيل بقايا المواد الغذائية عن الأدوات قبل تنظيفها؟ 1 بالغمر 2 بمياه جارية 3 بالدعك 4 أخرى

55)ما نوع مواد التنظيف المستخدمة ؟ 1 صابون سائل 2 معجون صابون 3 سائل+ معجون

56)عملية التعقيم للأدوات تجري بواسطة؟ 1 مياه دافئة 2 مياه قريبة للغليان 3 مياه بدرجة الغليان

57) هل يتم تخزين الأدوات بعد تنظيفها جافة في مكان خاص ؟ 1 نعم 2 لا

2-4- التخلص من النفايات

58) هل تستخدم حاوية للنفايات الصلبة؟ 1 بغطاء محكم 2 بدون غطاء محكم

59) أنت تتخلص من النفايات؟ 1 عند امتلائها 2 في نهاية العمل 3 عند قدوم عامل النظافة

60) هل تنظف حاوية النفايات بعد التخلص من النفايات؟ 1 نعم 2 لا

61) مياه الصرف الصحي:

1 موصل بشبكة مياه الصرف الصحي العامة 2 موصل بحفرة امتصاصية 3 أقرب مكان في الشارع

2-5- حفظ المنتج

62) هل تبيع الجاتوه في المحل ؟ 1 نعم 2 لا

63) هل تحفظ المنتج النهائي والمواد الخام في نفس الثلاجة؟ 1 نعم 2 لا

64) هل يوجد للثلاجة مؤشر درجة حرارة؟ 1 نعم 2 لا

65) ما هي درجة الحرارة؟ 1 أقل من 5 درجة مئوية 2 من 5 – 10 درجة مئوية 3 أكثر من 10 درجة مئوية 4 لا أعرف

66) هل يتم إضافة مواد كيميائية حافظة ؟ 1 نعم 2 لا

موقفك من ناحية وجهة نظرك:

67) هل تريد زيادة مساحة المصنع لسهوله العمل وحركة العمال؟ 1 نعم 2 لا

68) هل تحتاج لخبرة أكثر؟ 1 نعم 2 لا

69) يوجد لديك محفزات كافية؟ 1 نعم 2 لا

70) هل العمال يعملون حسب الأصول أثناء صناعة الكيك؟ 1 نعم 2 لا

تغليف المنتج:

71) ما هو نوع مادة التغليف؟ 1 كرتون 2 بلاستك 3 كرتون + بلاستك 4 أخرى............

72) هل مواد التغليف المستخدمة نظيفة؟ [1] نعم [2] لا

73) هل مواد التغليف تخزن في مكان خاص ؟ [1] نعم [2] لا

74) عنوان مصنع الجاتوه:

[1] الشجاعية [2] الدرج [3] التفاح [4] الزيتون [5] الصبره [6] الرمال [7] معسكر الشاطئ [8] الشيخ رضوان [9] أخرى

75) اسم المصنع:

76) عدد العمال في المصنع؟

77) هل المكان مرخص؟ [1] نعم [2] لا //// [redacted]///// إذا كانت الإجابة بنعم هل تم تجديد الترخيص ؟ [1] نعم [2] لا

78) الجهة التي تقوم بعملية التفتيش على المصنع؟ [1] وزارة الصحة [2] البلدية [3] وزارة الصحة & البلدية

79) مساحة المصنع [1] كافي [2] غير كافي [3] أخرى

80) أرضية المصنع؟ [1] ناعمة وسهلة التنظيف [2] غير ناعمة [3] يوجد شقوق.

81) التهوية: [1] كافية [2] غير كافية.

82) الإضاءة: [1] جيدة [2] مقبولة [3] غير مقبولة

83) نوعية السقف: [1] باطون مسلح [2] أسبست [3] زينكو [4] أخرى

84) مصدر المياه المستخدمة؟ [1] بلدية [2] بئر خاص [3] أخرى/ حدد.

85) هل يوجد لديك مخزون ماء إضافي؟ [1] نعم [2] لا.

86) إذا كانت الإجابة بنعم، ما هو نوع خزان المياه؟ [1] بلاستك [2] معدن [3] أخرى.

87) هل يتم تنظيف الخزان ؟ [1] نعم [2] لا

الأدوات:

88) هل الأدوات والمعدات مصنوعة من؟ [1] ستايلستيل [2] حديد [3] ألمونيوم [4] ستايلستيل + ألمونيوم [5] جميع ما ذكر

89) هل هي ملساء ؟ [1] نعم [2] لا

90) هل خط الإنتاج مرتب تسلسلياً؟ [1] نعم [2] لا

91) يوجد إشراف داخلي على عملية سير العمل؟ [1] نعم [2] لا

Questionnaire Number:--------------------
Date:---------------------------------

Personal details

1) **Age:** --------

2) **Gender** 1 Male 2 Female

3) **Address** 1 Shigayia 2 Daraj 3 Toufah 4 Zitoun 5 Sabrah 6 Al Rimal 7 Shatei camp 8 Sheikh Rdwan 9 others mention

4) **Years of Education:**------

5) **Experience years in cake making:** ------

6) **Position in the work:** 1 Owner 2 Technical workers

7) **Do you have any courses of training in cake production, GMP and GHP**? 1 Yes 2 No

Personnel Hygiene

I-Health status:

8) **Do you make a periodic routine medical examination?** 1 Yes 2 No

9) **Has any medicine been prescribed related to the result of medical examination?** 1 Yes 2 No

10) **In case you have fever, jaundice, diarrhea, and vomiting or discharges from the ears, eyes or nose. Do you?** 1 Stay at work 3 Change tasks 2 Stay at home.

11) **In case of injuries or abscises?** 1 Stay at home 2 Protected by secure waterproof covering

II-Personal cleanliness:

12) **Do you always cut your nails?** 1 Yes 2 No

13) **Do you wash your hands with soap while working?** 1 Yes 2 No

14) **Do you wash your hands after using the toilette?** 1 Yes 2 No

15) **Do you wash your hands after smoking?** 1 Yes 2 No 3 No smoking

16) **Do you wash your hands after touching clothe, skin and hair** 1 Yes 2 No

17) **Do you wash your hands after changing the place in the process line?** 1 Yes 2 No

18) **Do you wash your hands after eating?** 1 Yes 2 No

19) **Do you wash your hands after discharging wastes?** 1 Yes 2 No

20) **Do you wash your hands before staring work?** 1 Yes 2 No

21) **Do you wash your hands after handling raw materials (ingredients)?** 1 Yes 2 No

22) **Do you use antiseptic substances after washing your hands?** 1 Yes 2 No

23) **Do you wear special uniform during work**? 1 Yes 2 No

24) **Do you change your work uniforms?**

    1 Daily 2 Once/2days 3 Once/3days 4 Once/week 5 when it dirty.

25) **Do you keep your uniforms in special place?** 1 Yes 2 No

26) **Do you use gloves during decorate in final product?** 1 Yes 2 No

27) **If yes, it is** 1 disposal 2 Not disposal

III-Personal Behavior:

28) **Do you wear any rings, jewels, pins and hand watch while working?** 1 Yes 2 No

29) **Do you smoking, spitting, chewing, eating or setting on works tables during the work?**

    1 Yes 2 No.

30) **Do you cover the mouth and nose when you sneezing or coughing?** 1 Yes 2 No

31) **Do you wash your hands after sneezing or coughing or change gloves?** 1 Yes 2 No

Scientific background

1-knowledge about food microbial contaminant:

32) **Is the microbe?** 1 Bacteria 2 Mould 3 Yeast 4 Virus 5 All of them 6 Don't know.

33) **Do you think that microbe is?** 1 Useful 2 Harmful 3 All 4 I don't know.

34) **Do you know that microbe contaminate the food?** 1 Yes 2 No

35) **Source of contaminant come by**? 1 workers 2 Tools 3 Ingredient 4 Place 5 All of them.

36) **Do you think that microbes spoil the food?** 1 Yes 2 No.

37) **Have you hear about food poison caused by eating cakes?** 1 Yes 2 No 3 I don't now.

38) **Have you got any food poison from eating cakes?** 1 Yes 2 No 3 I don't

39) **Do know that the microbe grow and multiplying?** 1 Yes 2 No.

40) **If yes it needs suitable?**

    1 Temperature 2 PH 3 Food composition and moisture 4 All 5 Don't know.

2- Practice

2-1- Ingredient

41) **Do you purchase the ingredient from credit retailers?** 1 Yes 2 No .3 both

42) **If yes. Do you chick the ingredient before receiving according to specification?**

1 Yes 2 No

43) **Do you store the ingredient in special place?** 1 Yes 2 No.

44) **Do you applying first in first out system for ingredient stored?** 1 Yes 2 No.

45) **How do you handle with the unacceptable ingredient?**

1 back to the source 2 destroy 3 use it.

2-2-Pest control:

46) **Does the pest cause any problem in the plant?** 1 Yes 2 No

47) **Do you make any prevention against pest?** 1 Yes 2 No

48) **If yes, what is it?** 1 screen in windows 2 Doors closed well

3 Maintain the crake and holes closed 4 place cleaned 5 all above

49) **In case of existing insects the control is:**

1 Mechanical 2 Chemical 3 Electricity 4 Mechanical+ Chemical
5 Mechanical+ Electricity 6 Chemical+ Electricity 7 Mechanical+ Chemical+ Electricity

50) **In case of existing rodent the control is:**

1 Mechanical 2 Chemical 3 Electricity 4 Mechanical+ Chemical
5 Mechanical+ Electricity 6 Chemical+ Electricity 7 Mechanical+ Chemical+ Electricity

51) **Who does the pest control?** 1 Plant workers 2 expert 3 others, mention

52) **Chemical pesticides, do you store it in special place a far from process line and safe ?**

1 Yes 2 No

2-3- Cleaning and disinfectant:

53) **When you clean tools and equipments?**

1 When it became dirty 2 At the end of work 3 When change the work step 4 all above

54) **How you remove the remaining food particles from the utensils?**

1 Water immersion 2 running water 3 abrasion

55) **What type of cleaning materials ?** 1 Liquid soap 2 Paste soap 3 Liquid & Paste soap

56) **Disinfectant for tools and equipment don by ?**

1 Warm water 2 nearly boiling water 3 boiling water

57) **Do you store the cleaned utensils (tools) dried in special cleaned place?** 1 Yes 2 No**.**

2-4- Wastes and the means of discharge:

58) Do you use container for solid waste? 1 closed will with lid 2 without lid

59) Remove the solid waste container?

1 When it filled 2 at the end of work 3 when the sanitation worker came

60) Do you clean the container after discharge?

1 Yes 2 No

61) Discarded waste water?

1 Connected with the sewage net 2 Connected with absorb well 3 discarded in the vicinity

2-5- Product preservation:

62) Do you sell cake in the plant? 1 Yes 2 No

63) Do you store final product and ingredient in the same refrigerator? 1 Yes 2 No

64) Are the refrigerators having temperature indicators? 1 Yes 2 No

65) What is the temperature?

1 Less than 5°c 2 From 5°c -10°c 3. More than 10°c 4 I Don't know

66) Do you add any chemicals preservative? 1 Yes 2 No.

Attitude:

67) From point view do you want to increase the area of the plant for the process and movement of the workers? 1 Yes 2 No

68) Do you think that you need more experience? 1 Yes 2 No

69) Do you think that you have enough motivation? 1 Yes 2 No

70) Do you think that the workers consider GHP during process? 1 Yes 2 No

Product packaging materials:

71) What type of packaging material ? 1 paper (Carton) 2 plastic 3 others……….

72) Are the packaging material used clean? 1 Yes 2 No.

73) Are the packaging materials stored in special place? 1 Yes 2 No.

5th. Cake making plant Details

74) Address of cake making plant:

1 Shigayia 2 Darag 3 Tofah 4 Zitoun 5 Sabrah 6 Rimal 7 Sh.Camp 8 S. Rdwan 9 Others

75) The name of the plant:

76) Number of workers in the cake plant. ☐

77) **Do you ever have a valid license?** $\boxed{1}$Yes $\boxed{2}$ No

If yes, are you renew the license? $\boxed{1}$Yes $\boxed{2}$ No

78) **What is the official organization that run inspection at your facility?**

$\boxed{1}$ MOH $\boxed{2}$ Municipality $\boxed{3}$ Municipality+ MOH

79) **Area of the plant** $\boxed{1}$ Sufficient $\boxed{2}$ Insufficient $\boxed{3}$ others

80) **Floor** $\boxed{1}$ Smooth and easily cleaned $\boxed{2}$ Not smooth, $\boxed{3}$ Cleavages

81) **Ventilation**$\boxed{1}$ Enough $\boxed{2}$ Not enough

82) **Lightening:** $\boxed{1}$ Good $\boxed{2}$ Accepted $\boxed{3}$ Not enough

83) **Kind of the ceiling**$\boxed{1}$ Concrete$\boxed{2}$ Asbestos $\boxed{3}$ Metal roof $\boxed{4}$ others

84) **Source of water used?** $\boxed{1}$ Municipality $\boxed{2}$ Special well $\boxed{3}$ others, mentions.

85) **Do you have additional water reservoir?** $\boxed{1}$ Yes $\boxed{2}$ No

86) **If yes, what is the type of the water tank?** $\boxed{1}$ Plastic$\boxed{2}$ Metal $\boxed{3}$ Other

87) **Do you ever cleaned and disinfectant the water tank?** $\boxed{1}$ Yes $\boxed{2}$ No

Equipment

88) **Are the tools & utensils made from?**

$\boxed{1}$ Stainless steel $\boxed{2}$ iron $\boxed{3}$ Aluminum$\boxed{4}$ Stainless steel+ Aluminum $\boxed{5}$ all of them

89) **Are the tools smooth?** $\boxed{1}$ Yes $\boxed{2}$ No.

Process and production line:

90) **Is the production line arranged as the chain?** $\boxed{1}$ Yes $\boxed{2}$ No.

91) **Is there any internal inspection on the production line?** $\boxed{1}$ Yes $\boxed{2}$ No.

Annex 5

Palestinian National Authority
Ministry of Health
General Administration of P.H.C
Public Health Laboratory

السلطة الوطنية الفلسطينية
وزارة الصحة
الإدارة العامة للرعاية الأولية
مختبر الصحة العامة

FOOD MICROBIOLOGY REPORT تقرير فحص ميكروبيولوجي أغذية

Code No.........................الرقم السري: Substance name .... :اسم المادة

Trade mark...................علامة المنتج Producer name & addres ....اسم المنتج وعنوانه

Name & address of shopper man ....اسم صاحب البضاعة وعنوانه

Date..............تاريخ استلام العينة Expire...................تاريخ الانتهاء Product date..............تاريخ الإنتاج

Temp. at. Lab..............درجة الحرارة عند وصول المختبر Temp.............:درجة الحرارة عند أخذ العينة

From total...من اصل Qua. of sample.....................كمية العينة

Collect. By .... اسم آخذ العينة وجهة العمل

ملاحظات:...

....

اسم الفاحص:...

نتائج الفحص :

No	Sample	T.B.C	Staph. aureus	Coliform	E.coli	Sal.	Mold & Yeast				
							Mold	Yeast	O. Lacts		
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											

التاريخ:................................ رئيس القسم:.........................

مدير المختبر:.....................

PLAC

- المختبر مسئول عن العينات الواردة للمختبر.
- لا يجوز إعادة إصدار التقرير إلا بموافقة خطية من مدير المختبر.
- المختبر حاصل على شهادة اعتماد المختبرات (PSI 17)

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