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Assessment of Microbial Quality of Food Samples in Nablus District

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Dedication

To

MY MOTHER AND FATHER WITH LOVE AND GRATITUDE.

MY HUSBAND WITH LOVE, AND DEEP APPRECIATION.

MY SISTER AND BROTHERS

AND MY BELOVED CHILDREN KHALED, TAREQU, RAHAF, AND MOHAMMAD.

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Abbreviations

ARIJ: Applied Research Institution of Jerusalem

a_w: Water Activity or water availability.

CDC: Centers for Disease Control and Prevention.

CFSAN: Centers for Food Safety and Applied Nutrition.

CFU: Colony Forming Unit.

EHEC: Entero Hemorrhagic *Escherichia Coli.*

E.**Coli***: Escherichia Coli*

FDA: Food and Drug Administration.

FC: Faecal Coliform.

HACCP: Hazard Analysis and Critical Control Points.

HAV: Hepatitis A virus.

NIAID: National Institute of Allergy and Infectious Disease.

P - value: Probability (Significant Level)

SA: *Staphyllococcus Aureus.*

Sal: *Salmonella*.

TAC: Total Aerobic Count.

TC: Total Coliform.

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ABSTRACT

Data of microbiological food examination recorded between 1995-2003 at Environmental Health Department of Ministry of Health were analyzed and studied for microbial contamination in order to assess the variations of bacterial quality of food by type, source, months, seasons, years. A total of 1052 samples were collected from Environmental Health Department of Ministry of Health for routine test of microbiological quality for public health issue by Environmental Health Inspectors of Nablus district during the period 1995-2003.

This study showed that salads, meats and chickens and diary products had the highest percentages of unaccepted samples tested for TAC: these percentages are (62.1%), (14%) and (5.6%) respectively.

This study showed that the restaurants had the highest percentages of unacceptable samples tested for TAC, TC, *S aureus,* Yeast and Moulds These percentages are (56.9%), (65.6%), (1%), (75.9%), and (3%) respectively . This study conclude that lack of monitoring in restaurants, and food factories, and unsystematic food sampling system, due to the current situation such as closure and separation of the Palestinian territories by military checkpoints has created a lot of difficulties facing reporting, food sampling and consequently food control.

The study recommends conducting health education programs about food safety to food handlers, holding educational programs for public, and increasing the numbers of trained food inspectors.

CHAPTER ONE

CHAPTER ONE

Introduction

1.1 General Information about Nablus District

1.1.1 Location

Nablus district is located in the northern part of the West Bank. It is bounded by Jenin from the north, Tulkarm from the west, Ramallah and Jericho from the south and the Jordan River from the east. The district is located between 349 m below sea level and 918 m above sea level, (Applied Research Institute Jerusalem (ARIJ), 1996).

1.1.2 Topography

The topography of Nablus district can be divided into four parts:

1- Jordan Valley: is located between Jordan River and the eastern slopes with elevation ranges between 349 m below sea level to 100 m above sea level.

2- The eastern slopes: are located between Jordan valley and the mountains. They are characterized by steep slope which contribute to forming young wadis such wadi El Badan.

3- Mountain crests: from the water shed line and separate the eastern and western slopes. Elevation ranges on average between 750 and 800 meters above sea level.

4- Western slopes, characterized by gent slopes, with elevation ranges between 250-500 meters above sea level, (ARIJ, 1996).

The highest point in the district reaches 918 m above the sea level at Jabal Ibal, while the lowest elevation is 349 m below sea level at the south east corner of the district, (Nablus municipality, 2002).

1.1.3 Geographical Location

Nablus district is located at the northern latitude earth grid 32:12 and the eastern latitude earth grid 35:16. It's about 110 km far away from Amman, 42 km from Mediterranean, 66km from Jerusalem and Jenin and it is 550 m high from sea level (Nablus Municipality, 2003).

1.1.4 Temperature

The geographical position of Nablus district in the northern part of the West Bank gives it a comparatively lower temperature range than the other districts. During January, the coldest month, the average maximum temperature reaches 19.9 Cº, and the average minimum temperature reaches 2.6 Cº. During August, the hottest month, the average maximum temperature is 33.8 Cº and the average minimum temperature is 19.2Cº, as shown in table (1) (Palestinian Meteorology Department, (PMD) 2004).

1.1.5 Humidity

The mean annual relative humidity of Nablus district is 62%. During the khamaseen period, the relative humidity decreases to reach its minimum value of 18.0 % (in May). Maximum humidity of 89.5%, 90.5%, 91.0% are usually registered in December, January, and February respectively. This value increases gradually at night (ARI, 1996 and PMD, 2004).

Table 1. Maximum, minimum and average temperature degrees and humidity percentages for Nablus district for the years 1997- 2003

Month		Year/ Temperature					
		1997	**1998**	**1999**	**2000**	**2001**	**2003**
January	**Max**	24.0	17.0	19.8	23.5	21.0	14.0
	Av.	14.3	8.5	11.6	12.25	12.4	9.0
	Min.	4.6	0.0	3.4	0.0	3.8	4.0
February	**Max**	22.5	20.0	22.2	17.9	25.0	13.0
	Av.	11.25	11	13.1	10.8	14.7	8.6
	Min.	0.0	2.0	4.0	3.8	4.5	4.2
March	**Max**	23.5	24.6	26.2	25.5	32.2	14.2
	Av.	12.8	13.3	15.9	14.2	20.1	10.8
	Min.	2.2	2.0	5.6	3.0	8.0	7.5
April	**Max**	35.5	36.0	31.5	33.2	32.4	21.7
	Av.	18.0	21.1	19.4	21.1	20.7	15.1
	Min.	0.6	6.2	7.4	9.0	9.0	8.6
May	**Max**	35.5	36.0	37.5	33.5	37.3	34.0
	Av.	22.8	32.5	24.9	22.2	24.6	24.5
	Min.	10.2	11.0	12.4	11.0	12.0	15.0
June	**Max**	36.1	33.2	32.2	35.0	35.0	33.4
	Av.	25.0	23.7	24.1	25.4	25.2	24.4
	Min.	14.0	14.3	16.0	15.8	15.4	15.4
July	**Max**	33.5	34.4	32.5	37.5	33.5	35.4
	Av.	26.1	26.4	25.4	28.2	26.0	27.3
	Min.	18.7	18.4	18.3	19.0	18.6	19.2
August	**Max**	31.6	37.0	35.5	32.5	33.4	32.5
	Av.	24.2	28.5	26.9	26.0	26.8	26.2
	Min.	16.8	20.0	18.4	19.6	20.2	20.0
September	**Max**	24.5	37.5	37.2	36.0	31.6	32.6
	Av.	24.2	27.0	27.9	25.7	24.8	24.1
	Min.	14.0	16.6	18.6	15.5	18.0	15.6
October	**Max**	35.0	34.9	30.6	33.2	33.4	33.0
	Av.	23.3	23.6	22.5	21.8	22.6	22
	Min.	23.3	23.6	22.5	21.8	22.6	22
November	**Max**	11.6	12.4	14.4	10.4	11.8	11.0
	Av.	17.6	19.6	17	17.4	15.6	19.6
	Min.	10.0	10.8	5.0	9.4	5.8	9.6
December	**Max**	23.0	26.5	24.2	19.5	21.8	19.5
	Av.	13.8	15.5	14.4	12.7	13.3	12.1
	Min.	4.6	4.5	4.6	6.0	4.8	4.8
January.	**Max**	93	91	92	95	87	85

Month		Year/ Temperature					
		1997	1998	1999	2000	2001	2003
	Av.	63	70.5	66	70	60	59.5
	Min.	33	50	40	45	33	34
February	Max	91	92	87	93	93	90
	Av.	62	67	59.5	62.5	65	61
	Min.	33	42	32	32	37	32
March.	Max	88	91	86	86	85	86
	Av.	58.5	62.5	55.5	64.5	52.5	54
	Min.	29	34	25	43	20	22
April	Max	86	87	84	79	79	80
	Av.	51	51	52.5	52.5	48.5	52
	Min.	16	15	21	26	20	24
May	Max	80	90	73	71	83	66
	Av.	50	54	42.5	48.5	51.5	38.5
	Min.	20	18	12	26	20	11
June	Max	74	74	76	74	70	68
	Av.	47.5	51.5	55	47	45.5	45.5
	Min.	21	29	34	20	21	23
July	Max	71	76	75	73	74	71
	Av.	51	50	60.5	52.5	55.5	46.5
	Min.	31	24	46	32	37	22
August	Max	78	74	75	79	74	75
	Av.	62	57	59	63	66	60
	Min.	46	40	43	47	58	45
September	Max	84	76	77	77	76	72
	Av.	62	45.5	44.5	59	64.5	54
	Min.	40	15	12	41	53	36
October	Max	82	77	77	83	88	80
	Av.	54.5	43	59.5	53	61.5	54.5
	Min.	27	9	42	23	35	29
November	Max	91	80	81	77	90	89
	Av.	62	57	48.5	52	66.5	58.5
	Min.	33	34	16	27	43	28
December	Max	92	87	88	89	92	89
	Av.	62.5	58.5	54.5	65.5	66	66
	Min.	33	30	21	42	40	43

*The information for the year 2002 is not available.

** Max: means maximum, Min: means minimum, Av. Means average

1.1.6 Population

The estimated total population of the Nablus District is 341,412 for the year (2004), representing 8.75% of the total population of Palestine, (Palestinian Central Bureau of Statistics (PCBS), 2004).

Approximately 47.9% (120382) of the population of the Nablus district live in rural area. 10.5% (approximately 26447) lives in refugee camps and 41.6% (104563) lives in communities under municipalities' administration (PCBS, 2003).

1.2 Statement of the Problem

The aim of this study is to assess microbial quality of food in Nablus district and to study the related food borne diseases, to do so, food samples were taken from different sources, different time and during the years 1995-2003 and tested for microbial contamination

1.3 Objectives

The objectives of the study is to estimate the variations of bacterial quality of food by the type, source, months, seasons, years, the effect of treating food items by preservatives or heat before consumption in factories or preparation sites and recommending of some solutions to the problem of food contamination are also suggested.

1.4 Target Groups

- Samples were collected by MOH – Environmental health department from different sites, times during the years 95-2003 and studied at the central public health lab (CPHL) in Rammallah.

- Parameters studied were TAC, TC, *Salmonella, Staph*. Yeast and molds, standard methods were used to collect and test samples.

- The results were categorized into accepted, or unaccepted according to Palestinian standards, WHO Standards and Gulf states standards.

1.5 Limitations:

1. One of the limitations of this study is that the samples did not include the location of the samples were (city, camp, and village) because it was neglected by the sheet designer in the MOH.

2. For security purposes the source of samples was deleted by the ministry of health inspectors so we will find in results that a large number of samples of unknown source.

3. data in the years 1996, 1998 and 2001 were not available from records of environmental health department thus were not included in this study.

CHAPTER TWO

CHAPTER TWO

LITRATURE REVIEW

2.1 Definition of Terms.

Food Poisoning is an illness caused by ingestion of contaminated food.

1- Chemical Food poisoning is an illness caused by ingesting food containing chemical poison.

2- Food Intoxication is an illness caused by ingesting food containing microbial toxins.

3- Foodborne Diseases are infectious diseases spread through or by consuming contaminated foods or beverages (National Institute of Allergy and Infectious Disease (NIAID) 2002).

Foodborne diseases are common, distressing and some times life-threatening problem for millions of people around the world. In USA, centers for disease control and prevention (CDC) "estimates 76 million people suffer foodborne illnesses each year accounting for 325,000 hospitalizations and more than 5,000 deaths", (CDC. 2002). According to WHO "while less well documented, developing countries, bear the brunt of the problem of the presence of a wide range of foodborne illnesses, including those caused by parasites, bacteria, viruses", (WHO, 2002).

Foodborne outbreak is defined as illness in at least two persons with digestive symptoms that can be attributed to the same food source, (Hopkins, 2000).

Small outbreaks are likely to occur more frequently than outbreaks involving a large number of persons. Such outbreaks would be expected to be especially prolific in families or among other groups of people living together because they would often be exposed to the same risk factors (Ethelberg and Olsen, 2003).

2.2 Main Food borne Diseases

2.2.1- Bacterial Infections

The Majority of all Cases of Food Poisoning are due to Bacterial Infections.

2.2.1.1- Salmonellosis

In 1885 An American veterinary scientist, Daniel E.Salmon, discovered the first strain of *Salmonella* from the intestine of pig. This strain was called *Salmonella Choleraesuis,* the designation that is still used to describe the genus and species. *Salmonella* is type of bacteria that cause typhoid fever and many other infections of intestinal origin (Clark, 2002). *Salmonella* species are Gram-negative, flagellated facultative anaerobic bacilli most are motile with peritrichom flagella, ferment glucose with the production of acid and gas or acid only .Some *Salmonella* produce H2S (Jawetz, Melnick, and Adelberg's, 2004)

Compared with other gram-negative rods, *Salmonella* is relatively resistant to various environmental factors, grow at temperatures between 8Cº and 45Cº and in a pH range of 4 to 8 (Adams, 1995).

Salmonella is often pathogenic to humans and animals .Infection results from the ingestion of food or water containing sufficient number of these bacteria to reach and invade the small intestine (Adams, 1995).

Salmonella produce three main types of disease in humans: Enteric fever (Typhoid fever), Bacteremia and Enterocolitis, but mixed forms are frequent (Jawetz, Melnick, and Adelberg's, 2004).

Most cases of salmonellosis are considered to be endemic or sporadic because they are not clustered. The usual explanation for endemic cases is the inappropriate handling in kitchens and restaurants of contaminated food (including improper storage, undercooking, or cross contamination) (Blaser, 2004).

According to CDC "Every year, approximately 40,000 cases of Salmonellosis are reported in the United States and it is estimated that approximately 600 persons die each year with acute Salmonellosis (CDC, 2004).

According to Hopkins "In France, *Salmonella* is involved in 75.6 percent of reported foodborne outbreaks with an identified causative organism, 70 percent of which occur in family household" (Hopkins, 2000).

Symptoms of salmonellosis in clued fever, abdominal pain, diarrhea and vomiting.

Associated Foods

1- Contaminated beef meats, raw poultry.

2- Unwashed fruits.

3- Vegetables grown in contaminated soils.

4- Eggs (NIAID, 2002).

Some types of *Salmonella* can infect a hen's ovary so that the internal contents of a normal looking egg can be contaminated with *Salmonella* even before the shell is formed (CDC, 2003).

The consumption of under cooked eggs or egg products contaminated with *S. enteritidis* is the major cause of salmonellosis (Hennessy, 2004). In USA, *Salmonella enteritis* has become the most commonly reported serotype of *Salmonella* causing disease in humans (Hennessy, 2004).

2.2.1.2 Typhoid Fever

Typhoid fever is a life threatening illness caused by *Salmonella typhi.* (CDC, 2001). *Salmonella Typhi* lives only in humans; persons with typhoid fever carry the bacterium in their blood stream and intestinal tract (CDC, 2001). Typhoid fever is common in most parts of the world except in industrialized regions such as United States, Canada, Western Europe, Australia and Japan (CDC, 2001).

According to WHO "Typhoid fever is still common in the developing world, where it a affects about 12.5 million persons each year, (WHO, 2004).

Patients with typhoid fever usually have a sustained fever as high as (39-40C°). They may also feel weak or have stomach pain, headache or loss of appetite. In some cases, patients have a rash of flat and rose- colored spots. The only way to know for sure if an illness is typhoid fever is to have samples of stool or blood tested for the presence of *S.typhi* (CDC, 2001).

The disease is Prevented by:

1. Avoid foods and beverages from street vendors.

2. Avoid unpasteurized milk and milk products.

3. Cook poultry and egg thoroughly.

4. Avoid unwashed and unpeeled fruits.

2.2.1.3 Escherichia Coli Infections (Facal Coliform)

E.coli is facultative gram negative rods, motile with beritrichom flagella organism: it causes traveler's food poisoning. Certain types of *E.coli* can cause food borne illness. Harmless strains of *E.coli* is found widely in nature, most strains are considered to be part of GIT of man and other warm blood animals including intestinal tracts of humans and warm-blooded animals (NIAID, 2002).

Several different strains of harmful *E.coli* can cause diarrheal disease. A particularly dangerous type is called entero hemorrhagic *E.coli* of EHEC. Often causes bloody diarrhea and can lead to kidney failure in children or people with weakened immune systems (FDA, 2001).

In 1982 scientists identified the first dangerous strain in the United States, the type of harmful *E.coli* most commonly found in USA named 0157:H7 which refers to chemical compounds found on the bacterium's surface. This type produces one or more related, powerful toxins which can severely damage the lining of the intestines (FDA, 2001).

According to CDC "an estimated 73,000 cases of infection and 61 deaths occur in the United States each year" (CDC, 2004).

In USA, 47 airline passengers suffered from illness strongly associated with eating garden salad made from iceberg and romaine lettuce, endive, and shredded carrots (Beuchat, 1996).

In another outbreak, 78 lodge guests become ill after consuming tossed salad as part of a buffet dinner. The salad contained several ingredients, including onions, carrots, peppers, mushrooms and tomatoes, (Beuchat, 1996).

In 1996, an outbreak of *E.Coli* 0157: H7 in Japan affected over 6.300 school children resulted in 2 deaths. This is the largest out break ever recoded for this pathogen (WHO, 2002).

Associated Food

1. Undercooked or row hamburgers or ground beef.
2. Unpasteurized milk, apple juice, and apple cider.
3. Unwashed and contaminated raw vegetables and fruits (NIAID, 2002).

Symptoms of *E. Coli* 0157: H7 Infection

E.coli toxin can damage the lining of the intestine and cause other symptoms including Nausea , Several abdominal cramps , watery or very blood diarrhea , tiredness , vomiting (CDC, 2004)

Prevention of *E.Coil* 0157:H7 Infection.

1. Personal hygiene because the bacteria can be passed from one person to another if hygiene or hand washing habits is inadequate (CDC, 2004).

2. Adequate heat treatment for ground beef and milk.

3. Washing fresh fruits and vegetables thoroughly before eating raw or cooking them, (NIAID, 2002).

2.2.1.3- Clostridium Botulinum Infections

Clostridium botulinum: is anaerobic, Gram positive spore forming rod that produces a potent neurotoxin. The spores are heat-resistant and can survive in foods that are incorrectly or minimally processed, (CDC, 2003).

Seven types (A, B, C, D, E, F and G) of botulism are recognized based on the antigenic specificity of the toxin produced by each strain, types A, B, E, and F cause human botulism, types C and D causes most cases of botulism in animals. Animals most commonly affected are wild fowl and poultry, cattle, horses, and some species of fish (CDC, 2004).

Clostridium spores are heat-resistant and can be destroyed only at temperatures above boiling. This is why canned food must be cooked to a high temperature under pressure as part of the canning process (NIAID, 2002).

Toxins that cause botulism are completely inactivated by boiling. It can be destroyed at 80C˚ for 10 minutes or longer (CDC, 2003).

Botulism: is a rare serious paralytic illness caused by a nerve toxin that is produced by bacterium *C. botulinum* (CDC, 2004). Botulism occurs when the *C. botulinum* grows and produces a powerful paralytic toxin in foods. These toxins can produce illness even if the microbes that produced them are no longer there (CDC, 2003).

According to CDC "in USA Health care providers report an average of 110 cases of food, infant and wound botulism to CDC each year, and about 10 -30 out breaks of foodborne botulism are reported every year (CDC, 2001). Out breaks involve two or more persons, and usually caused by eating contaminated home-canned foods (CDC, 2004).

Infective Dose: a very small amount (few nanograms) of toxin can cause illness. The incidence of disease is low but the disease of considerable concern because of its high mortality rate if not treated immediately and properly .The onset of symptoms in food borne botulism is usually 18 to 36 hours after ingestion of the food containing toxins, although some cases have varied from 4 hours to 8 days (CDC, 2003).

Associated Foods

Almost any types of food that is not very acidic (pH above 4.6) can support growth and toxin production by *C. Botulinum*. Canned corn, peppers, green beans, soups, beets, mushroom, ripe olives, spinach, tuna fish, chicken, luncheon meats, sausage , smoked and salted fish (CDC, 2003).For more details, see Table (2).

Symptoms

1. Double vision and dropping eyelids.

2. Slurred speech

3. Dry mouth and difficulty swallowing

4. Weak muscles.

2.2.1.4- *Clostridium Perfringens* Infections

Clostridium perfringens is anaerobic, endospore former that produce a variety of toxins as well as gas during growth. It is the cause of gas gangrene. Some strains produce enterotoxins which cause food poisoning (Jawetz, Melnick, and Adelberg's, 2004). These microorganisms and their endospores have been isolated in many foods especially among red-meats, poultry, and sea food. Also from vegetable coated with soil or dust. People working in the kitchen may cross contaminate foods after using the toilet and not washing their hands.

The incubation period is 8-22 hours and duration of illness is 12-24 hours symptoms; abdominal pains and diarrhea, the patient rarely vomits. Some endospores of this microorganism are killed in few minutes at 100C° where as other require 1-4 hours at this temperature for complete destruction (CDC, 2004). Growth of Clostridium perfringens can be prevented by levels of curing salts and pH 6.2 or below (Gibson and Roberts, 1996).

Prevention

- Proper heat treatment of foods especially canned foods.

- Proper refrigeration of food

2.2.1.5- *Campylobacter* Infections

Campylobacter: is a bacterial pathogen that causes fever, diarrhea, and abdominal cramps. It is the most commonly identified bacterial cause of diarrhial illness in the world.

These bacteria live in the intestines of healthy birds, and most raw poultry meat has been contaminated with juices dripping from raw chicken which is the most frequent source of this infection (CDC, 2003).

Campylobacteriosis: is an infectious disease caused by bacteria of the genus *campylobacter*. Most human illness is caused by one species, called *campylobacter jejuni*, but 1% of human campylobacter cases are caused by other species (CDC, 2004).

Other species like *C. fetus* and *C. Coli* can also cause compylobacteriosis usually occurs in a single, sporadic cases but it can also occur in outbreaks, when a number of people become ill at one time. Most cases of infections are associated with handling raw poultry or eating raw or under cooked poultry meat (CDC, 2004).

According to CDC, "*C. Jejuni* is the leading cause of bacterial diarrheal illness in the united states, affecting an estimated 2.4 million people every year. The bacteria causes between 5 and 14 percent of all diarrheal illness world wide. *C. Jejuni* primarily affects children under 5 year's old and young adults (15-24 years old) (CDC, 2003).

In a prospective case control study in Norway it is found that there are associated factors with an increased risk of *Campylobacter* infection these drinking undisinfectd water, eating at barbecues, eating poultry

bought raw, having occupational exposure to animals, and eating under cooked meat. The following factors were related to a decreased risk: eating mutton, raw fruits or berries, and swimming. Results indicate that infection is more likely to occur as a result of cross contamination from raw poultry products than because of poultry consumption" (Kapperud, and others, 2004).

Symptoms of Campylobacteriosis

1. Diarrhea (often bloody).
2. Abdominal cramping and pain.
3. Nausea and vomiting
4. Fever and tiredness.

Some infected people have no symptoms. Campylobacteriosis usually last for 2-5 days, but in some cases as long as 10 days (CDC, 2003).

Prevention of Campylobacteriosis

- Personal hygiene.
- Proper cooking of poultry and poultry products.
- Pasteurization of milk and milk products not less than 70C°.
- Boiling of drinking water.
- Proper cleaning and disinfection of preparation surfaces and utensils.

2.2.1.6- Staphylococcus Aureus

Staphylococcus aureus: is a spherical bacterium (coccus) which on microscopic examination appears in pairs, short chain or bunched, grape-like clusters. These organisms are Gram-positive. Some strains are capable of producing a highly heat-stable protein toxin that causes illness in humans (CDC, 2003). *Staphylococci* exist in air, dust, sewage, water, milk and food or on food equipment and environmental surfaces. Humans and animals the primary reservoirs, *Staphylococci* are present in the nasal passages and throat and on the hair and skin of 50 percent or more of healthy individuals. (CDC, 2003).

Staphylococcal Food Poisoning

Staphyloenterotoxicosis is the name of the condition caused by enter toxins which some strains of *S. aureus* produce (CDC, 2003).

According to FDA "An outbreak of staphylococcal foodborne illness was linked to canned mushrooms, growth and toxin production occurred prior to processing the mushrooms, without significant visual degradation, possibly because the mushrooms were held under ambient conditions in plastic bags with salt. Conditions within the bags rapidly become anaerobic and the toxin is heat stable" (FDA, 2001).

Staphylococcus aureus can grow in some foods and produce a toxin that causes intense vomiting; this toxin cannot be inactivated by boiling (CDC, 2003).

The onset of symptoms in staphylococcal food poisoning is usually rapid and in many cases acute, depending on individual susceptibility to the

toxin, the amount of contaminated food eaten, the conc. of toxin in the food ingested, and the general health of the victim, (CDC, 2003).

Associated Foods

Foods that require considerable handling during preparation which are meats and meat products, poultry and egg products, salads, milk and milk products.

Common Symptoms

Nausea, Vomiting, abdominal cramping and prostration. In more sever cases, headache, muscle cramping and transient changes in blood pressure and pulse rate may occur (CDC, 2003).

2.2.1.7- Streptococcus SPP.

The genus *streptococcus* is comprised of Gram-positive micro aerophilic cocci (round) which are not motile and occur in chains or pairs. The genus is defined by a combination of antigenic, hemolytic, and physiological characteristics into groups, A, B, C, D, F and G. group A and D can be transmitted to human via foods (CDC, 2003).

Group A: sore and red throat, pain on swallowing, tonsillitis, high fever, headache, nausea, vomiting, malaise.

Onset 1-3 days, the infectious dose is probably quite low (< 1000 organisms).

Group D: Diarrhea, abdominal pain, nausea, vomiting, fever, chills, dizziness that occur in 2-36 hours after exposure the infectious dose is high (>107 organisms).

Associate Foods

Group A food sources include milk, ice cream, eggs, steamed lobsters, potato, salads, egg salad, custard, rice, pudding. Entrance into the food is the result of poor hygiene, ill food handlers or the use of unpasteurized milk (CDC, 2003).

Group D food source include sausage, evaporated milk, cheese, meat, raw milk. Entrance into the food chain is due to under processing or poor and unsanitary food preparation.

2.2.1.8- Shigellosis

The genus *shigella* is composed of four species, *shigella dysenteries, Shigella boydii, Shigella sonnei* and *Shigella flexneri*. All species are pathogenic to humans at low dose of infection (FDA, 2001).

Shigellosis is usually transmitted from person to person but many also occur by consumption of contaminated water and foods, including foods such as fruits or vegetables that have received little or no heat treatment. (FDA, 2001). Several large outbreaks of shigellosis have been attributed to the consumption of contaminated raw vegetables.

According to FDA. "There are many out breaks associated with lettuce consumption. One of which was caused by *S.sonnei* that occurred simultaneously on two university campuses in Texas. On both campuses 111 students had eaten salads from self – serve salad bars, lettuce was the only produce item used in salad consumed by all students, who become ill". (Centers for Food Safety and Applied Nutrition & FDA, 2001).

In another out break of *S.sonnei* gastroenteritis was associated with eating shredded lettuce. All implicated restaurants received shredded lettuce from the same facility. An investigation suggested that a worker in the plant was the source of contamination and that the method of processing allowed contamination of the lettuce, (FDA, 2001).

Two Midwestern United States outbreaks of *S. Flexner* infection have been linked to the consumption of fresh green onion. The onions were traced to shippers in California who obtained most of their green onions from a single farm in Mexico. It was concluded that contamination may have occurred in Mexico at harvest or during package .So according to FDA reports that "*Shigella sonnei* can survive on lettuce at 5C° for 3 days without decreasing in number, and increased by more than 1000 fold at 22C°. *Shigella* can grow in shredded cabbage, chopped parsley stored at 24 C° (FDA, 2001). See Table 2.

2.2.2 Viral Infections

Viruses can be excreted in large numbers by infected individuals and have been isolated from sewage and untreated waste- water used for crop irrigation. Although viruses cannot grow in or on foods, but their presence on fresh produce, which may serve as vehicles for infections, is of concern (FDA, 2001).

Hepatitis A

Hepatitis A can be transmitted through food if handled in unsanitary conditions.

Hepatitis A virus (HAV) is a common form of acute viral hepatitis in many parts of the world. It is responsible for significant worldwide

morbidity and occasional mortality. Outbreaks of hepatitis A occur periodically throughout the word, and fecaly contaminated food and water are the main vehicles (Bidawid, 2000).

Hepatitis A is caused by hepatitis A virus (HAV).Transmission occurs by the fecal – oral route, either by direct contact with an HAV- in fected person or by ingestion of HAV- contaminated food or water (Fiore, 2004).

According to Cruz and Oswaldo 2002 "there are three epidemiological patterns have been described world wide. In high endemic area with poor sanitary conditions, all children older than 10 years are immune to HAV. In these regions, outbreaks of the disease are uncommon and morbidity is low because in most children the infection is asymptomatic. In developed countries with better sanitary facilities, exposure to HAV during childhood is less common. In these areas, there are large numbers of susceptible adults creating the potential for out breaks.

Finally developing countries demonstrate an intermediate endemicity with a growing number of adolescents and young a adults susceptible to HAV infection. This situation is due to the fact that improvements in sanitary conditions reduced the exposure to HAV in early childhood although the virus has not been eliminated from the environment". (Cruz, 2002).

Symptoms of HAV: nausea, vomiting, abdominal pains, diarrhea, fever, hepatomegally, jaundice and darkening (Cruz, 2003).

Table 2. Characteristics of some microbial pathogens that have been linked to out breaks of food illness.

Microorg-Anism	Incuba-Tion Period	Symptoms	Infectious Dose/(Number Of Cells)	Source
Clostridium Botulinum	12-36 hour	Fatigues dizziness, dryness of mouth and throat, muscle paralysis difficulty of swallowing, double or blurred vision, drooping eyelids, and breathing difficulties. Death due to respiratory paralysis or Cardiac arrest	Intoxication growth and toxin production in food.	Soil lakes streams decaying vegetation
Escherichia Coli 0157: H7	2-5day	Bloody diarrhea, abdominal pain. Can lead to hemolytic uremic syndrome and kidney failure especially in children and the elderly.	10-1000	Animal feces, especially cattle, deer and human cross contamination from raw meat.
Salmonella SPP	18 to 72 hour	Abdominal pain, diarrhea chills, fever, nausea, vomiting.	10 to 100.000	Animal and human feces, cross contamination from raw meat, poultry, or eggs.
Shigella SPP	1 to 3 day	Abdominal pain, diarrhea, fever, vomiting.	= 10	Human feces.
Hepatitis A	25-30day	Fever, malaise, anorexia nausea.	10 to 50	Human feces and urine

Source: U.S. Food ad Drug Administration. (2001).

2.2.3 Yeast

Yeast: the presence of yeast in foods creates spoilage and produce a slimy or cloudy appearance and by creating metabolic by products – especially through fermentation. They have widely different requirements for growth but generally require a high a_w (is the amount of water available for deterioration reactions and is measured on a scale of 0 to l.0) than molds and yeast grow with or without oxygen and fermentation occurs under anaerobic conditions (Kuntz, 1996).

2.2.4 Molds

Type of multicellular fungus, generates food spoilage with rot discoloration and off-flavor production. They may produce human toxins, as in the case of aflatoxins peanuts (Kuntz, 1996).

Molds require free oxygen, a fairly high water old activity (a_w), mesophilic temperature range (8-35C°) and as lightly acidic to neutral environment (Kuntz, 1996).

2.3 Factors Affecting the Growth of Microorganisms in Food

Several factors encourage, prevent, or limit the growth of the microorganisms in food.

2.3.1- Foods: food is a chemically complex matrix. Most foods contain sufficient nutrients to support microbial growth, (FDA, 2003). The food substances are likely to be invaded by a variety of microorganisms. The type of food substances and the methods by which they are processed. Most of foods serve as good media for microbial growth. These microorganisms when given a chance to grow bring changes in natural

properties such as appearance, flavor, odor, taste, color, Etc, of the contaminated food thus causing spoilage (Lammerding and Paoli, 1999).

Most bacteria prefer foods that have high content of protein and moisture like meats, poultry, seafood, dairy products, cooked rice, beans and potatoes.

1- Meat group

a- Red Meats

The interior portions of meat are usually free of microbial contaminations if healthy animals are properly slaughtered. The fresh cut meat gets immediately contaminated with microorganisms derived from gloves, hands, implements used to cut the meat, hides, hair, intestines of the animals and the environment of the slaughter house. Each new surface of meat, resulting from a new cut, adds more microorganisms to the exposed tissue, the most common microorganisms occurring on fresh meat include *Clostridium, Escherichia Salmonella*, *and Streptococcus*. (FDA, 2001). Consumption of red meats increased in Palestine during feasts, Ramadan, and special occupations (Hammad. 2003).

b- Poultry

The surface of freshly dressed eviscerated poultry has microbial flora, which is derived from the live birds or from the manipulations during killing, defeathring and evisceration. Species of *Bacillus, Enterobacter, Escherichia, Salmonella* and *Staphylococcus* constitute the major microbial flora on the skin of freshly dressed eviscerated poultry (Lammerding and Poali, 1999).

c- Eggs

Clean eggs with uncracked shell normally don't contain microorganisms within. Poor sanitary and storage conditions under which it is held determine it's subsequent microbial content. Bacteria and Molds may enter the egg through cracks in the shell, (Lammerding and paoli, 1999).

2- Cereals Groups

Cereals and cereal products contain microorganisms from insects, soil and other sources. *Bacillus, lactobacillus, and micrococcus*. Which are generally found on freshly harvested grains. Molds like *Aspergillus, penicillum* are also very common, (Lammerding and Poali, 1999).

3- Fruits and Vegetables

Fresh fruits and vegetables can be contaminated if they are washed or irrigated with water that is contaminated with animal manure or human sewage (CDC, 2003).

Generally the fruits are acid foods (pH below 4.5). While nearly all vegetables, fish, meat and milk products are non- acid foods (pH above 4.5) (FDA, 2001).

During the production of fruits and vegetables. There are many points at which the produce can become contaminated with pathogens. The majority of them are related to contamination with pathogenic microorganisms through manure (for example through fertilization practices or run off contamination) water (for example irrigation water) and soil, (FDA, 2001).

2.3.2- Acidity (pH Value)

There is a pH optimum for each microorganism at which growth is maximal. Moving a way from the pH optimum in either direction slows microbial growth (FDA and CFSAN, 2001). The pH affect the growth of microorganisms in food, most spoilage organisms prefer a pH in the slightly acidic to neutral ranges although proteolytic bacteria thrive in alkaline environments. By adjusting the PH, the spoilage can be a chivied, with a higher degree of protection from spoilage (Kuntz, 1996).

2.3.3 - Temperature

Temperature values for microbial growth like pH values have a minimum and maximum range with an optimum temperature for maximal growth. The growth at extremes of temperature determines the classification of an organism (e.g. psychrotroph, thermotroph). The optimum growth temperature determines its classification as theromphile, mesophile, and psychrophile (FDA, 2001). Lowering temperatures results in a slowdown in the growth of organisms. Temperature below freezing stops the growth of most organisms. Freezing can be lethal to some microorganisms by formation of ice crystals (Kurtz, 1996).

2.3.4 - Time

Bacteria reproduce by binary fission. Their multiplication therefore corresponds to a geometric progression: $2^0 \rightarrow 2^1 \rightarrow 2^2 \rightarrow 2^3 \rightarrow 2^n$.

Generation time/time interval for one division of bacteria. As an example the generation time for *E.Coli* (doubling time) is 21 min at 40C^o (Schlegel, 1984).

However, when low acid food (food with a neutral or alkaline pH) is abused by placing it in the (5-60C) longer than two hours, pathogens multiply rapidly. Restricting the time that low acid foods stay in this temperature to two hours or less prevents growth of large numbers of pathogens, (Food Safety, 2004).

2.3.5- Oxygen

In the relation of oxygen at least three groups of organisms can be distinguished. Obligate aerobes can obtain their energy only via aerobic respiration and are dependent on oxygen. Obligate anaerobes can grow only in the absence of oxygen; for these oxygen is toxic. Facultative anaerobes can grow either in the presence or absence of oxygen. Most foodborne disease causing microorganisms are facultative anaerobes (Shlegel, 1984).

2.3.6- Moisture

All microorganisms must have an abundant supply of water to grow. Moisture content is the amount of water in food and expressed as a percentage. Water activity (a_w) is the amount of water available for deterioration reactions and is measured on a scale of 0 to l.0. Bacteria, yeast and molds multiply rapidly at a high water activity (> 0.86). Meat products and soft cheeses have a_w in this range (0.86 - 1.0) (Food Safety, 2004).

Pathogenic bacteria have difficulty growing in foods such as jams and jellies, flours, etc. where a_w is (< 0.85), because salt and sugar deprive microorganisms of water and inhibit their reproduction. These

products are shelf stable (they do not need refrigeration) (Food Safety, 2004).

2.4 Food Microbial Quality Indicators.

2.4.1 Total aerobic Count (TAC)

The aerobic plate count indicating the level of microorganisms in a product and provides general estimate of live, aerobic, bacteria (excludes, obligate anaerobes), some times can be useful to indicate quality, shelf life and post heat processing contaminations (Maturin and peeler, 1998). .

2.4.2 Coliform Group (TC) and Fecal Coliform (FC)

The coliform group contains all aerobic and facultative anaerobic, gram negative, non-spore forming rods able to ferment lactose with the production of acid and gas at 32 Cº or 35 Cº within 48 h, (Adams, 1995).

The genera include:

1- Klebsiella: maybe found in feces and in the environment.

2- Escherichia: found always in human and other animal feces.

3- Enterobacter: found in feces and in the environment.

4- Serratia: found in environment.

2.4.3 *Staph. Aureus*

2.4.4 *Salmonella*

2.4.5 Yeast and Molds

Coliforms can be Classified Into Fecal or Non-Fecal Origin

The fecal coliform group is referred to as organisms that grow in the gastrointestinal tract of human and warm blooded animals and includes members of three genera: Escherichia, Klebsiella, and Enterobacter, (Adam, 1995).

Fecal coliform bacteria, which belong to the entereobacteriaceae are present in large numbers in the feces and intestinal tracts of human and other warm-blooded animals and can enter water bodies from human abdominal waste. If large number of fecal coliform bacteria (over 200 colonies/100 milliliters (ml) of water sample) it is possible that pathogenic disease or illness causing organisms are also present in the water (WHO, 2000).

2.5 Factors Contributing to the Emergence of Food Borne Illnesses

Outbreaks occur wherever pathogenic agents in sufficient number or quantity encounter a susceptible population without effective measures, (Hall, 1998).

1- Genetic Variability

The large genetic variability of microorganisms is the principle reason why so often some microorganisms survive after any unfavorable environmental change. Some strains are hyper mutable, which reinforces the potential for survival and have very short generation times. (Hall, 1999).

2- Environment

Environmental factors also contribute to emergence of foodborne illnesses; hot humid climates favor the growth of fungi and the production of mycotoxins (CDC, 1999).

3- Behavior (Travelers, Refugees, and Immigrants)

Human actions and behavior directly affect food safety. People are vectors for disease, traveling from place to another more rapidly than ever before (CDC, 1999). According to WHO, it is estimated that about 90% of all cases of salmonella in Sweden are imported (WHO, 2002).

4- Urbanization

Urbanization is a major factor in emergence. Crowding increase human contact and chances for transmission particularly in developing countries where the health services are far away from the villages and farms, so there will be gab in reporting the cases of outbreaks and investigations or disease surveillance will be very low, (Hall, 1999).

5- Denial

A behavior that encourages outbreaks is denying the existence of an epidemic. This practice is more common in developing countries because they are concerned about the effect of outbreak publicity on tourist trade and exports (Hall, 1999).

6- Economics

War and economic collapse provide opportunities for disease outbreaks. The infrastructure that provides clean water, community medicine, disease surveillance, and food control all of these are easily affected by economic disruption (CDC, 1999).

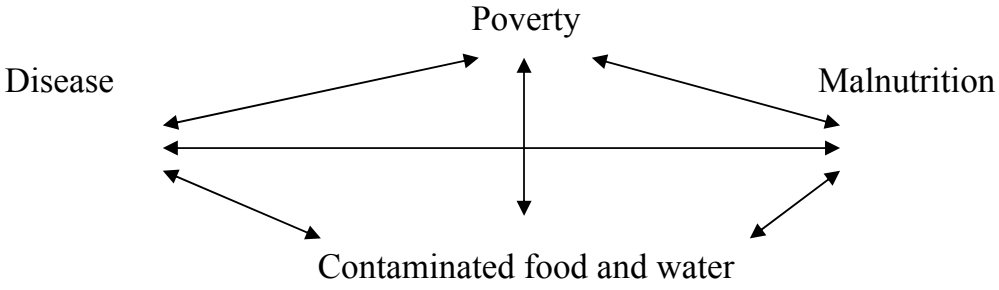
7- Risk Factors

These factors such as age, illness, behavior that promotes the incidence of diseases.

8- Interacting Factors

The developing world, an interrelated and mutually reinforcing set of problems keeps foodborne disease at a high level as shown in figure 1**.**

Figure 1. problems causing foodborne diseases in developing countries.
Source: (Hall, 1999).



High Risk Groups that are Affected by Foodborne Illnesses.

1- Pregnant women.

2- The elderly

3- People with weakened immune systems

4- A bottle-fed infant is at higher risk for severe infections with salmonella or other bacteria that can grow in a bottle of warm formula if it is left at room temperature for many hours.

5- Persons with liver disease (CDC, 2003).

2.6 Important Definitions that are of Great Concern in this Field

1- Clean food or food-contact surfaces are washed and rinsed and are visually free of dust, dirt, food residues and other debris; (CDC, 1998).

2- Control measures any action or activity that can be used to prevent, reduce, or eliminate a microbiological hazard (CDC, 1998).

3- Sanitize to treat clean food by a process that is effective in destroying or substantially reducing the numbers of microorganisms of public health concern, as well as other undesirable microorganisms, without adversely affecting the quality of the food product or its safety for the consumer (CDC, 1998).

4- Food Code: contains standards for restaurants safety which is updated every 2 years, it includes temperature for cooking, cooling, refrigeration, reheating and holding food in food- service establishments (Collins, 1999).

5- cross contamination: is the transfer of bacteria from foods (usually raw) to other foods. The bacteria can transfer directly when one food comes in contact with another or indirectly for example from hands, equipments, tools, or working surfaces (NIH, 2003).

6- Hazard analysis: critical control points (HACCP).

Hazard analysis: identification of sensitive ingredients, critical processing points, and human factors that affect product safety, (Collins, 1999).

Critical points/ processing determinants whose loss of control would result in an unacceptable food safety risk (Collins, 1999).

Most contend that the HACCP system approach must be implemented at each stage of the farm- to – family continuum. Where are the critical control points and HACCP system development in the home, food service or retail establishments, or the car when food is carried from one location to another (Collins, 1999).

In a study between 2001-2002 performed on 27 catering establishments in Ferrara (Italy) they took a total of 236 inspections after a HACCP system was introduced and educational programs for food staff was undertaken for approximately l0 years they found that the hygienic quality of services and foods has improved in comparison with previous surveys, showing that the staff educational programs and the application of HACCP principles have increased the level of awareness regarding food hygiene in those working in catering services (Kegnani and others, 2004).

Table (4) summarizes Food born illness reports from restaurants in USA.

Restaurants and Food Services

Recent data indicates that 80% of reported foods borne illness outbreaks occur outside the home. Even though illnesses would be expected to be reported more, often they occur as a result of eating in restaurants (CDC, 1996).

2.7 Principles of Handling and Hygienic Control of Foods in Restaurants and Home.

Food handling is an important factor in food safety. This includes the safety practices among those preparing and /or serving food as well as mode and duration of food storage.

There are two main practices in food handling which increase the risk of foodborne diseases. First is preparation of food several hours before consumption and storage at temperatures that favor growth of pathogens and/or formation of bacterial toxins. Second is insufficient cooking or reheating of preserved food, (Walczak, 1998)

Table 3. Food born illness reports from restaurants in USA, 1996.

Date /Year	No. of Cases	Description	Cause
Junuary/1996	38	*Salmonella*	Employees did not wash hands be fore handling food (contaminated food).
Septemper/1995	11	*Escherichia coli O154: H7*	Raw food cross contaminated other "beef".
August/1995	850	*Salmonella Newport*	Raw chicken on cutting board with vegetables.
January/1995	95	*Hepatitis A*	Human fecal matter from handling hand washing. (Contaminated food).
August./1994	56	*Salmonella*	Holding temperature too low for 9hours (Hollandaise sauce).
January/1993	7cases 1death	*Clostridium botulinium*	Un refrigerated storage of opened container (canned cheese sauce).

Source: Center of science in the public interest, (1996).

According to Atiya 2003 "the Palestinian, preventive medicine department MOH thought that the outbreaks occurred from restaurants

and houses meal, in Palestine can be considered a second major food poisoning. Recently, in 2002 outbreak occurred in hebron, where 51 cases of food poisoning were reported after consumption of soup and meat in a restaurant in Ramadan" (Atiya, 2003).

In a case study conducted by Al-Khatib about microbial quality of food samples from restaurants and sweetshops in Ramallah and al-Bireh district. Utilizing food sample test results of Palestinian Ministry of Health, records to the years 1995, 1996, 2000, 2002, and the first 2 months of the year 2003, the results revealed that only 60.9%, 44.0%, 63.8%, 93.6%, 51.8%, 83.8%, and 50.4% of the food samples tested for total aerobic count, total *Coliform, faecal Coliform, Staphylococcus b aureus, faecal Streptococci*, moulds, and yeasts respectively are within the limits of the limits of the Palestinian and International standards. None of the tested samples for *Salmonella* or *Clostridium perfringes* were positive. The results of this study demonstrate a rise in the number of restaurants and sweet shops in the Ramallah/ al-Bireh urban area over time, ongoing and unacceptably high levels of contamination of tested food samples and the absence of clear guidelines and regulations for food handling in general. (Al-Khateeb, et.al. 2004)

2.8 General Rules to Reduce the Hazards of Foodborne Illnesses in Restaurants and Food Preparation Services.

1. The establishment must be provided with an approved water supply and sewage disposal system.

2. No person with symptoms or flu, gastrointestinal upset, throat, sinusitis, cough, infected cuts or sores or other contagious diseases shall work as a food handler or where food is prepared or served.

3. While on duty, all food service personnel must wear clean outer garments, maintain a high degree of personal cleanliness and conform to accepted hygienic practices, including proper hand washing. Suitable hair restraints must be used.

Hand washing is recognized as the single most important measure to prevent cross contamination, because infected employees who work with food increase the risk of transmitting foodborne illnesses, (Worsfolds and Griffith, 2004).

In an investigation about the transfer of HAV during contacts of hands Bidawid, farber and Sattar found that "Touching the lettuce with artificially contaminated finger pads for l0 sec at a pressure of 0.2 to 0.4 kg/cm^2 resulted in transfer of 9.2% ± 0.09% of the infectious virus".(Bidawid ,Firebrand Sater , 2000)

So the last experiments makes clearl the importance of hand washing and their role in cross contamination process and miss-handling can occur at any points In food chain, in processing, at supermarkets or restaurants, or in home (Collins, 1999).

4- Training

There are many areas of training for the employees, they should train for:

1- The Importance of Good Hygiene

All personnel should understand the impact of poor personnel cleanliness and unsanitary practices on food safety. Good hygiene not only protects the workers from illness, but it reduces the potential for contamination of foods which if consumed by the public, could cause a large number of illnesses (FDA, 1998).

2- The Importance of Hand Washing

Thorough hand washing before commencing work and after using the toilets is very important. Many of the diseases that are transmissible through food may be harbored in the employee's intestinal tract and shed in the feces. Contaminated hands can also transmit infectious diseases (FDA, 1998).

3- The Importance of Proper Hand Washing Techniques

The workers should know how to wash their hands properly which include the following.

- Hand washing with water. Warm water is more effective than cold water for washing hands
- Use of soap.
- Thorough scrubbing (including cleaning under fingernails and between fingers) rinsing and drying of the hands (FDA, 1998).

CHAPTER THREE

CHAPTER THREE

METHODOLOGY

Data about food samples microbiological quality from different sources and related possible food borne diseases was collected from the records of Nablus Health Directorate/Ministry of Health (MOH) for Nablus district for the years 1995-2003 with a population of 341,412 persons in 2004 (PCBS).

The samples were collected for routine test of microbiological quality for public health issue by Environmental Health Inspectors of Nablus district. Also the maximum and minimum temperature and moisture degrees were collected for the years 1997-2003 from the Meteorology Department of Nablus district to observe the relation between the indicator microorganisms with temperature, moisture and food related disease. Numbers of food and sweets restaurants, food stores and food factories were collected from Nablus municipality and Nablus Chamber for Commerce and Industry .Interviews with the Environmental Health Inspectors in Nablus District and public health officials in Nablus municipality were done.

3.1. Samples Collection

Samples were collected for analysis by Environmental Health inspectors in Nablus District and sent to central Public Health Lab in Ramalla for analysis. Microbiological food quality indicators which are (total aerobic count, Total Coliforms, fecal coliforms, *Staphylococcus*

aurous, streptococcus, Salmonella. Yeast and molds), as these are the only indicators tested by the MOH.

Samples were collected for laboratory analysis at 0-4C° in clean and dry containers and transported on a weekly basis, and tested by the Central Public Health Laboratory, a body of the MOH in Ramallah.

A sample unit consists of a minimum of 100 grams. The inspectors used sterile plastic cups of 200 gram, using the same spoon in which the workers of restaurants used, so the samples must be taken from the same dish in which people were served from.

But for dry samples: randomly collected from many places of 100 grams, and kept in plastic containers.

3.2. Receiving Samples at the Laboratory

As soon as samples arrive at the laboratory, time of collection and temperature are checked within 4 hours of receipt, samples are examined immediately or kept in the refrigerator for 24 hours of collection to be examined later. Samples are divided into three groups.

1- Frozen samples should be received frozen, and the temp should be below 0c° preferably - 10 C°

2- Refrigerated samples should be received refrigerated with temp between 0-4 C°

3- Dry and canned samples should be received at ambient temp. This is between 15-25 C°

3.3. Samples Analysis

A total of 1052 samples were coded and entered into the computer and analyzed using the statistical analytical system (SPSS).

3.3.1 Samples Categorization

The samples were categorized and many cross tabulations were done like (food types, samples source, cooked or uncooked, with or without preservatives, years, months and seasons).

3.3.2 Sample Types

The samples were categorized into eight groups. Fruit and vegetables, meat and chicken, cereal, diary product, salads, sweets, others and unknown and they were 18, 174, 27, 207, 32, 164, 332, and 55 samples respectively.

Other includes (baking powder, vinegar, food additives, food colors, candies, jellies, tehenia, ect) or any food which contains more than two types of foods or mixture.

3.3.3 Samples Source

Samples were collected by Environmental health inspectors from many food establishments, restaurants, supermarkets, houses, food factories, others, unknown, 61, 3, 1, 281, 4, and 646 samples respectively.

Others includes (farms, schools, slaughterhouse)

3.3.4 Cooked or Uncooked Samples.

The samples also categorized according to the heat treatment, if the samples were cooked or not, the canned and pasteurized samples categorized as cooked. The numbers of cooked samples were 645, uncooked samples were 202 and others were 149 samples.

Others includes (smoked foods, salted foods)

3.3.5 Samples With or Without Preservatives

The samples also categorized into those that contain preservatives and those without preservatives. All canned foods categorized as with preservatives and other food items without preservatives and they were 14, 982 respectively.

3.3.6 Samples Distribution According to Years, Seasons and Months.

The samples also categorized according to years, seasons, and months between the years 1995- 2003.

3.4 Acceptance of Samples

Decisions regarding whether food samples were deemed acceptable or not acceptable for food preparation and/or human consumption were based on the Palestinian microbiological standards, WHO standards, and Gulf states standards, where each type of food is assigned a specific upper limit for the presence of microbes (Al-Khatib.2004) The bacteriological analytical manual online published by the U. S. Department of Health and Human Services (2001) was used as a reference for sample testing.

3.5 Methods of Detection of Microorganisms in Food Samples at Lab.

3.5.1 Detection of Total Coliforms in Diary and General Food Products.

Procedure: add 50 g or 50 ml of test sample to200 1 peptone water, and then blend in a stomacher for one minute at medium speed. Make -1 to-3 dilutions in saline. Make duplicate plates on violet red bile lactose (Merck, USA) (VRBL) or EMB.

Medium of each dilution spread plate technique, then incubate for 4 hours at 30c. Count colonies with diameter greater than 0.5 mm. And calculate the number of total Coliforms per gram or milliliter of sample. Subculture on BCP(MERCK, USA) and incubate for 4 hours at 30c.quality control: Both positive and negative organism control such as E. coli, Klebsiella, proteus and others, and negative media controls were included with each batch of samples.

Confirmation: Kligler test, ONPG, Methyl red, Voges- prokauer, citrate, lactose fermentation and glucose fermentation.

3.5.2 Determination of Fecal Coliforms in Dairy and General Food Products.

Procedure: Add 50g. or 50 ml of test sample to200 1 peptone water, then blend in a stomacher for one minute at medium speed. Make -1 to-3 dilutions in saline. Make duplicate plates on VRBL or EMB medium of each dilution by spread plate technique. Incubate for 18- 24 hours at 44 C°, count red colonies with diameter greater than 0.5 m and calculate the number of fecal coliforms per gram or milliliter of sample.

Subculture on EMB Plates to Confirm *E.Coli.*

Quality control: Both positive and negative organisms control should be included with each batch of samples.

Confirmation tests: INDOL, ethyle red, voges-Proskaure, Citrate, Catalase, oxidase, glucose and lactose fermentation.

3.5.3 Detection of *S. Aureus* General Food Products.

Procedure: add 50 g or 50 ml of test sample to200 peptone water, and then blend in a stomacher for one minute at medium speed. Make -1 to-4 dilutions in saline. Make duplicate plates of each dilution spread plate technique. Plates should be Baird – Parker agar incubated for 18-48 hours at 37 C˚. Count Black colonies with clear zone around, and calculate the number of bacteria in 1.0 g or 1.0 ml of sample. Incubate Brain Heart infusion broth and incubate for 24 hours at 37 C˚, to confirm with coagulase test.

Quality control: Both positive and negative organism's controls and negative media controls were included with each batch of samples.

Confirmation tests: Mannitol hydrolysis, Cagulase test.

3.5.3 Detection of *Salmonella* in General Food Products.

Procedure: Add 25g. of test sample to 225ml, of peptone water or selenite cystine broth, Blend in stomacher for one minute at medium speed and, incubate for 16 hours at 37 C˚.

3.5.3.1 Isolation of *Salmonella*

Add 0.1 ml of culture (peptone water) to 10.0 ml of Rappaport medium, (Meid) and incubate for 24 hours at 42 C˚.

Selenite Medium (Merck, USA): Add 2.0 ml of culture (peptone water) to 20.0 ml of selenite cystine medium and incubate for 24 hours at 37 C˚.

Quality control: Both positive and negative organisms' controls and negative media controls were included with each batch of samples.

Confirmation tests: Biochemical identification and serological identification. Bizmuth Sulfite Plates: Inoculate 0.1 ml of rappaport medium or selenite or cystine medium onto bismuth sulfite plates for 24 hours at 37 C˚. Look for black colonies.

3.5.4 Detection of *Yeast and Molds* in General Food Products.

Procedure: add 50 g or50 ml of test sample to200 peptone water, and then blend in a stomacher for one minute at medium speed. Make -1 to-4. Make duplicate plates on YGC medium (Merck, USA) dilutions in saline of each dilution by spread plate technique; per incubate at 22 – 25 C˚ for at least 5 days. Count colonies and 5 days. Examine colonies under microscope to differentiate between yeasts and molds, and Gram stain for yeasts.

CHAPTER FOUR

CHAPTER FOUR

RESULTS

4.1. Distribution of Food Samples.

Data of microbiological food examination recorded between 1995-2003 at Environmental Health Department of Ministry of Health were analyzed and studied for microbial contamination in order to estimate the variations of bacterial quality of food by type, source, months, seasons, years. A total of 1052 samples where collected for routine test of microbiological quality for public health issue by Environmental Health Inspectors of Nablus district. The following tables show the distributions of these samples.

4.2. Microbial Quality and Food Types.

Table (4) shows that out of 646 samples tested for Total Aerobic Count (TAC). Salads, meats, and diary products have the highest percentages of not accepted samples which were 18(62.1%) 8(14%), and 10(5.6%), respectively.

The number and percentage of not accepted samples tested for *Total Coliform* (TC) for salads, fruit and vegetables, cereals ,diary products and meats, were 23(71.9%), 2 (11.1%), 3(11.1%),21(10.8%) ,and13(7.5%), respectively. For *Staphylococcus aureus* (SA) the number and percentage of not accepted samples for meats, diary products and salads were 1(0.6%) 5(2.4**%)** and 1(3.1%) respectively**.**

Meat and chickens, and diary products have the highest percentage of not accepted samples for *Salmonella* test which were 2.4% for Meat

and chickens and 0.5% for diary products**.** For yeast test the number and percentage of not accepted tested samples of meats and chickens, cereals, diary products and salads were 5(8.8%),1(25%), 11(5.6%) ,and 27(87.1%) respectively.

The number and percentage of not accepted tested samples for Moulds for cereals, diary products salads and sweets were 1(25%), 4(2.0%), 4(12.9%) and 3(2.5%) respectively.

Table 4. Sample types and the acceptance of various microbiological tests

Sample	TAC			TC			*S.aureus*		
	Accepted (%)	**Not Accept (%)**	**Total**	**Accepted (%)**	**Not Accept (%)**	**Total**	**Accepted (%)**	**Not Accept (%)**	**Total**
Fruit & Vegetable	2 (100)	0 (0.00)	2	16 (88.90)	2 (11.10)	18	12 (100)	0 (0.00)	12
Meat &Chicken	49 (86.00)	8 (14.00)	57	161 (92.50)	13 (7.50)	174	171 (99.40)	1 (0.60)	172
Cereal	3 (100)	0 (0.00)	3	24 (88.90)	3 (11.10)	27	23 (100)	0 (0.00)	23
Diary Product	168 (94.40)	10 (5.60)	178	173 (89.20)	21 (10.800)	194	202 (97.60)	5 (2.40)	207
Salad	11 (37.90)	18 (62.10)	29	9 (28.10)	23 (71.90)	32	31 (96.90)	1 (3.10)	32
Sweets	118 (98.30)	2 (1.70)	120	157 (95.70)	7 (4.30)	164	127 (100)	0 (0.00)	127
Other	189 (89.20)	23 (10.80)	212	302 (0.00)	30 (0.00)	332	245 (100)	0 (0.00)	245
Unknown	44 (97.80)	1 (2.20)	45	54 (98.20)	11 (0.80)	65	53 (100)	0 (0.00)	53
Total	584 (90.40)	62 (9.60)	646	896 (90.00)	100 (10.00)	996	864 (99.20)	7 (0.80)	871
Chi-Square	109.001			147.462					
P- Value	0.000			0.000					

Note:- * accept means accepted .
** not accept means not accepted .
*** TAC. Total Aerobic Count .
****T C. Total Coliform

Table 4. Continued

	Salmonella			Yeast			Moulds		
Sample	**(%) Accepted**	**(%) Not Accept**	**Total**	**(%) Accepted**	**(%) Not Accept**	**Total**	**(%) Accepted**	**(%) Not Accept**	**Total**
Fruit & Vegetable	100 9	0.00 0	9	100 2	100 0	2	100 2	0 0.00	2
Meat &Chicken	97.60 164	2.40 4	168	52 91.20	5 8.80	57	100 57	0 0.00	57
Cereal	100 11	0.00 0	11	3 75.00	1 250	4	75.0 3	25.0 1	4
Diary Product	99.50 206	0.50 1	207	186 94.40	11 5.60	197	98.0 193	2.00 4	197
Salad	100 32	0.00 0	32	4 12.90	27 87.10	31	87.1 27	12.90 4	31
Sweets	100 123	0.00 0	123	118 96.70	4 3.30	122	97.5 119	2.50 3	122
Other	100 236	0.00 0	236	194 89.80	22 10.20	226	99.50 215	5.00 1	216
Unknown	100 45	0.00 0	45	44 97.80	1 2.20	45	100 45	0.00 0	45
Total	99.40 826	0.60 5	831	603 89.50	71 10.50	674	98.1 661	1.90 13	674
Chi-Square				209.390			35.685		
P- Value				0.000			0.000		

4.3 Microbial Food Quality and Food Sources.

Table (5) shows that out of 58 samples taken from restaurants and tested for TAC, the number and percentage of not accepted samples were 33(56.9%), while out of 257 samples taken from food factories and 323 samples of unknown source; the number and percentage of not accepted samples were only 6(2.3%) and 22(6.80%) respectively tested for the same test. Also table (5) shows that the number and percentage of not accepted samples taken from restaurants ,food factories and unknown source tested for TC were 40 (65.6%), 11(3.9%) and 48(7.4%) respectively. For *Staphylococcus aureus* the number and percentage of not accepted samples for restaurants, and unknown source were 1(1.6%) and 6(1.1%) respectively**.**

Table (5) shows that the number and percentage of not accepted samples taken from food factories or of unknown source and tested for *Salmonella* were 1(0.4%) and 4(0.8%) respectively**.** For yeast test the number and percentage of not accepted samples from restaurants, food factories and unknown source were 44(75.9 %), 7(2.7%), and 20(5.7%) respectively.

While the number and percentage of not accepted samples tested for Moulds taken from restaurants and unknown source were 3(5.2%), and 10(2.9%) respectively.

Table 5. Source of samples and acceptance of various microbiological tests**.**

Source	TAC			TC			S.aureus		
	(%) Accepted	(%) Not Accept	Total	(%) Accepted	(%) Not Accept	Total	(%) Accepted	(%) Not Accept	Total
Restaurants	43.10 25	56.90 33	58	34.40 21	65.60 40	61	98.40 60	1.60 1	61
Supermarket	100 3	0.00 0	3	100 3	0.00 0	3	100 3	0.00 0	3
Houses	100 1	0.00 0	1	100 1	0.00 0	1	100 1	0.00 0	1
Food Factory	97.70 251	2.30 6	257	96.10 270	3.90 11	281	100 267	0.00 0	267
Other	75.00 3	25.00 1	4	75.00 3	250 1	4	100 4	0.00 0	4
Unknown	93.20 301	6.80 22	323	92.60 598	7.40 48	646	98.90 529	1.10 6	235
Total	90.40 584	9.60 62	646	90.00 896	10.00 100	996	99.20 864	0.80 7	971
Chi-Square	169.586			226.265					
P- Value	0.000			0.000					

Table 5. Continued

Source	*Salmonella*			Yeast			Moulds		
	(%) Accepted	(%) Not Accept	Total	(%) Accepted	(%) Not Accept	Total	(%) Accepted	(%) Not Accept	Total
Restaurants	100 61	0.00 0	61	24.10 14	75.90 44	58	94.80 55	5.20 3	58
Supermarket	100 3	0.00 0	3	100 3	0.00 0	3	100 3	0.00 0	3
Houses	100 1	0.00 0	1	100 1	0.00 0	1	100 1	0.00 0	1
Food Factory	99.60 263	0.40 1	264	97.30 253	2.70 7	260	100 260	0.00 0	260
Other	100 4	0.00 0	4	100 4	0.00 0	4	100 4	0.00 0	4
Unknown	99.20 494	0.80 4	498	94.30 328	5.70 20	348	97.10 338	2.90 10	348
Total	99.40 826	0.60 5	831	89.50 603	71.00 28.2	885	98.10 661	1.90 13	674
Chi-Square				289.014					
P- Value				0.000					

3.4. Microbial Quality and Cooked Foods.

According to the results shown in table (6) the total number of cooked samples tested for TAC is 468 , of which 34(7.3%) were not accepted. For uncooked samples out of 75 samples tested for TAC 22(29.3%) were not accepted**.** For TC, out of 645 cooked tested samples, 56(8.7%) samples were not accepted, while out of 202 uncooked tested samples, 42(20.8%) were not accepted.

For *S. aureus*, out of 566 cooked tested samples, 5(0.9%) samples were not accepted. However, out of 188 uncooked tested samples, 2(1.1%) were not accepted.

For yeast, out of 492 cooked tested samples, 36(7.3%) samples were not accepted. While out of 78 cooked tested samples, 31(39.7%) were not accepted.

For Moulds, out of 492 cooked tested sample, 7(1.4%) were not accepted and out of 78 uncooked tested samples, 6(7.7%) were not accepted.

Table 6. Numbers and percentages of acceptable, and unacceptable for cooked or uncooked samples

Type Of Specimens	TAC			TC			*S.aureus*		
	(%) Accepted	(%) Not Accept	Total	(%) Accepted	(%) Not Accept	Total	(%) Accepted	(%) Not Accept	Total
Cooked	2.70 434	7.30 34	468	91.300 589	8.70 56	645	99.10 561	0.90 5	566
Uncooked	70.70 53	29.30 22	75	79.20 160	20.80 42	202	98.90 186	1.10 2	188
Other	94.20 97	5.80 6	103	98.70 147	1.30 2	149	100 117	0.00 0	117
Total	90.40 584	9.60 62	646	90.00 896	10.00 100	996	99.20 864	0.80 7	871
Chi-Square	38.293			39.652					
P- Value	0.000			0.000					

Table 6. Continued

Type of Specimens	*Salmonella*			Yeast			Moulds		
	(%) Accepted	(%) Not Accept	Total	(%) Accepted	(%) Not Accept	Total	(%) Accepted	(%) Not Accept	Total
Cooked	99.60 548	0.40 2	550	92.70 456	7.30 36	492	98.60 485	1.40 7	492
Uncooked	98.30 171	1.70 3	174	60.30 47	39.70 31	78	92.30 72	7.70 6	78
Other	100 107	0.00 0	107	96.20 100	3.80 4	104	100 104	0.00 0	104
Total	99.40 826	0.60 5	831	89.50 603	10.50 71	674	98.10 661	1.90 13	674
Chi-Square				80.952			16.409		
P- Value				0.000			0.000		

4.5. Microbial Food Quality and Preservatives

According to the results shown in table (7) the total number of samples with preservatives tested for TAC is 11, of which (0.0%) were not accepted. For samples without preservatives out of 635 samples tested for TAC 62(9.8%) were not accepted**.** For TC, out of 982 tested samples without preservatives 100(10.2%) samples were not accepted, while out of 14 tested samples with preservatives, 0(00.0%) were not accepted.

For *S. aureus*, out of 857 tested samples without preservatives, 7(0.8%) samples were not accepted. However, out of 14 tested samples, 0(0.0%) were not accepted.

For yeast, out of 663 tested samples without preservatives, 71(10.7%) samples were not accepted. While out of 11 tested samples with preservatives, 0(0.00%) were not accepted.

For Moulds, out of 663 tested sample without preservatives, 13(2.0%) were not accepted and out of 11 tested samples with preservatives, 0(0.0%) were not accepted.

Table 7. Numbers and percentages of acceptable, and unacceptable samples with or without preservatives.

Preservative	**TAC**			**TC**			***S.aureus***		
	(%) Accepted	**(%) Not Accept**	**Total**	**(%) Accepted**	**(%) Not Accept**	**Total**	**(%) Accepted**	**(%) Not Accept**	**Total**
With Preservative	100 11	0.00 0	11	100 14	0.00 0	14	100 14	0.00 0	14
Without Preservative	90.20 573	9.80 62	635	89.80 882	10.20 100	982	99.20 850	0.80 7	857
Total	90.40 584	9.60 62	646	90.00 896	10.00 100	996	99.20 864	0.80 7	871

Table 7. continued.

Preservative	***Salmonella***			**Yeast**			**Moulds**		
	(%) Accepted	**(%) Not Accept**	**Total**	**(%) Accepted**	**(%) Not Accept**	**Total**	**(%) Accepted**	**(%) Not Accept**	**Total**
With Preservative	100 14	0.00 0	14	100 11	0.00 0	11	100 11	0.00 0	11
Without Preservativ	99.40 812	0.60 5	817	89.30 592	10.70 71	663	98.00 650	2.00 13	663
Total	99.40 826	0.60 5	831	89.50 603	10.50 71	674	98.10 661	1.90 13	674

4.6. Numbers and Percentages of Acceptable and Unacceptable Samples during the Different Months of the Years 1995- 2003.

Data presented in table (8) shows The number and percentage of not accepted samples for TAC test which were 22(28.6%) in July , 7(15.2%) in August, 6 (13.6%) in November , and 7(12.3%) in May . For TC test the number and percentage of not accepted samples were 19(22.1%) in May, 17(17.7%) in July, 15(14.7%) in April, and 12(18.5%) in August.

For yeast test the number and percentage of not accepted samples were 18(30.5%) in May, 22(28.6) in July, 15(25.4%) in April, and 8(16.7%) in August. For *M*oulds The number and percentage of not accepted tested samples were 3(12.5%) in February 5(8.5%) in April, and 3(5.1%) in May.

Table 8. Numbers and percentages of acceptable and unacceptable samples during the twelve months of the years 1995-2003.

Month	TAC			TC			*S.aureus*		
	(%) Accepted	(%) Not Accept	Total	(%) Accepted	(%) Not Accept	Total	(%) Accepted	(%) Not Accept	Total
January	97.00 32	3.00 1	33	97.20 70	2.80 2	72	100 50	0.00 0	50
February	100 21	0.00 0	21	98.10 53	1.90 1	54	100 37	0.00 0	37
March	96.80 30	3.20 1	31	97.90 47	2.10 1	48	100 49	0.00 0	49
April	90.60 48	9.40 5	53	85.30 87	14.70 15	102	97.70 85	2.30 2	87
May	87.70 50	12.30 7	57	77.90 67	22.10 19	86	96.30 79	3.70 3	82
June	90.60 48	9.40 5	53	89.50 68	10.50 8	76	100 70	0.00 0	70
July	71.40 55	28.60 22	77	82.30 79	17.70 17	96	100 88	0.00 0	88
August	84.80 39	15.20 7	46	81.50 53	18.50 12	65	98.30 59	1.70 1	60
September	93.80 91	6.20 6	97	93.70 104	6.30 7	111	100 106	0.00 0	106
October	96.20 50	3.80 2	52	94.30 82	5.70 5	87	98.60 68	1.40 1	69

Month	TAC			TC			*S.aureus*		
	(%) Accepted	(%) Not Accept	Total	(%) Accepted	(%) Not Accept	Total	(%) Accepted	(%) Not Accept	Total
November	86.40 38	13.60 6	44	89.20 66	10.80 8	74	100 69	0.00 0	69
December	100 82	0.00 0	82	96.00 120	4.00 5	125	100 103	0.00 0	103
Total	90.40 584	9.60 62	646	90.00 896	10.00 100	996	99.20 864	0.80 7	871
Chi-Square	52.237			47.828					
P- Value	0.000			0.000					

Table 8. Continued

Month	*Salmonella*			Yeast			Moulds		
	(%) Accepted	(%) Not Accept	Total	(%) Accepted	(%) Not Accept	Total	(%) Accepted	(%) Not Accept	Total
January	100 39	0.00 0	39	97.10 33	2.90 1	34	97.10 33	2.90 1	34
February	100 35	0.00 0	35	87.50 21	12.50 3	24	87.50 21	12.5 3	24
March	97.80 45	2.20 1	46	96.80 30	3.20 1	31	100 31	0.00 0	31
April	98.70 74	1.30 1	75	74.60 44	25.40 15	59	91.50 54	8.50 5	59
May	100 81	0.00 0	81	69.50 41	30.50 18	59	94.90 56	5.10 3	59
June	100 66	0.00 0	66	100 57	0.00 0	57	100 57	0.00 0	57
July	100 88	0.00 0	88	71.40 55	28.60 22	77	100 77	0.00 0	77
August	100 58	0.00 0	58	83..30 40	16.70 8	48	100 48	0.00 0	48
September	100 106	0.00 0	106	99..00 98	1.00 1	99	100 99	0.00 0	99
October	97.10 66	2.90 2	68	98.10 53	1.90 1	54	100 54	0.00 0	54
November	100 68	0.00 0	68	97..90 47	2.10 1	48	97.90 47	2.10 1	48

Month	*Salmonella*			Yeast			Moulds		
	(%) Accepted	(%) Not Accept	Total	(%) Accepted	(%) Not Accept	Total	(%) Accepted	(%) Not Accept	Total
December	99.00 100	1.00 1	101	100 84	0.00 0	84	100 84	0.00 0	84
Total	99.40 826	0.60 5	831	89.50 603	10.50 71	674	98.10 661	1.90 13	674
Chi-Square				105.375			39.360		
P- Value				0.000			0.000		

4.7. Numbers and Percentages of Acceptable and Unacceptable Samples in Years 1995- 2003.

Data presented in table (9) shows the number of tested samples for TAC test for the year 2002 were 97 and the number and percentage of not accepted samples for the same year were 12(12.4%) . In 2003 the number of samples were 549 with 50(9.1%) of not accepted samples for TAC test. For TC test, the number and percentage of not accepted samples tested for TC in 2003 ,2002, 1999, 1997 and 1995 were 61(10.9%), 11(10.8%) ,17(7.4%), 11(11.3%), and 0(0%) respectively. For *Staphylococcus aureus* The number and percentage of not accepted samples were 1(0.2%) 0(0.00%) ,5(3.6%),1(1.6), and 0(0%) respectively.

For *Salmonella*, the number and percentage of not accepted samples were 1(0.2%) , 0(0.00%) , 1 (0.9%) , 3(7.0%) and 0(0%) respectively. For yeast, the number and percentage of not accepted samples were 49(8.7%), 13(12.6%), 8 (100%), and 1(100%) respectively. For moulds, the number and percentage of not accepted samples was 4(0.7%), 0(0.0%), 8 (100%), and 1(100%) respectively. Figure (5) shows the relationship between the years and the acceptance of Salmonella test.

Table 9. Numbers and percentages of acceptable and unacceptable samples in years 1995- 2003

	TAC			TC			*S.aureus*		
Year	**(%) Accepted**	**(%) Not Accept**	**Total**	**(%) Accepted**	**(%) Not Accept**	**Total**	**(%) Accepted**	**(%) Not Accept**	**Total**
2002	87.60 85	12.40 12	97	89.20 91	10.80 11	102	100 103	0.00 0	103
2003	90.90 499	9.10 50	549	89.10 501	10.90 61	562	99.80 561	0.20 1	562
1995	- -=	- -	-	100 4	0.00 0	4	100 4	0.00 0	4
1997	- -	- --	-	88.70 86	11.30 11	97	98.40 63	1.60 1	64
1999	- -	- -	-	92.60 214	7.40 17	231	96.40 133	3.60 5	138
Total	90.40 584	9.60 62	646	90.00 896	10.00 100	996	99.20 864	0.80 7	871
Chi-Square							17.850		
p-value							0.001		

Table 9. Continued

	Salmonella			Yeast			Moulds		
Year	**(%) Accepted**	**(%) Not Accept**	**Total**	**(%) Accepted**	**(%) Not Accept**	**Total**	**(%) Accepted**	**(%) Not Accept**	**Total**
2002	100 103	0.00 0	103	87.40 90	12.60 13	103	100 103	0.00 0	103
2003	99.80 565	0.20 1	566	91.30 513	8.70 49	562	99.30 558	0.70 4	562
1995	100 4	0.00 0	4	- -	- -	-	- -	-	-
1997	93.00 40	7.00 3	43	0.00 0	100 1	1	0.00 0	100 1	1
1999	99.10 114	0.90 1	115	0.00 0	100 8	8	0.00 0	100 8	8
Total	99.40 826	0.60 50	876	89.50 603	10.50 71	674	98.10 661	1.90 13	674
Chi-Square	31.716			78.878			464.042		
p- Value	0.000			0.000			0.000		

4.8. Number and Percentage of Acceptable and Unacceptable Samples in the Four Seasons for the Years 1995-2003.

Data presented in table (10) shows that the number of samples tested for TAC were 220, 194, 178, and 54 in Summer, Spring, Autumn, and Winter respectively. The number and percentage of not accepted samples were 35(15.9%) , 18(9.3%) , 8(4.5%) and 1(1.9%) respectively . also the table shows that 272 , 296, 286 , and 107 samples were taken in Summer , Spring , Autumn, and Winter respectively . The number and percentage of not accepted samples tested for TC were 36(13.2%) , 39(13.2%) , 18(6.3%) and 3(2.8%) respectively ,and 272 , 296, 286 , and 106 samples were taken in Summer , Spring , Autumn, and Winter respectively .

For *Salmonella* the number of samples taken in Summer, Spring, Autumn, and Winter were 252, 259, 237 and 71 respectively. The number and percentage of samples tested for *Salmonella* were 1(0.4%) , 1(0.4%) ,3(1.3%) and 0(0.0%) for the seasons Summer , Spring , Autumn, and Winter .

Data presented in table (10) shows that 224 , 204, 186, and 58 samples tested for yeast were taken in Summer , Spring , Autumn, and Winter respectively . The number and percentage of not accepted samples were 31(13.8%) , 32 (15.7%), 2 (1.1%)and 4 (6.9%). Also data presented in table (10) shows that 224, 204, 186, and 58 samples tested for moulds were taken in Summer, Spring, Autumn, and Winter respectively. The number and percentage of not accepted samples were 0(0.0%), 6 (2.9%), 1 (0.5%) and 4 (6.9%).

Table 10. Numbers and percentages of acceptable and unacceptable samples in the four seasons for the years 1995-2003.

Season	**TAC**			**TC**			***S.aureus***		
	(%) Accepted	**(%) Not Accept**	**Total**	**(%) Accepted**	**(%) Not Accept**	**Total**	**(%) Accepted**	**(%) Not Accept**	**Total**
Spring	90.70 176	9.30 18	194	86.80 257	13.20 39	296	98.20 274	1.80 5	279
Summer	84.10 185	15.90 35	220	86.80 236	13.20 36	272	99.60 253	0.40 1	254
Autumn	95.50 170	4.50 8	178	93.70 268	6.30 18	286	99.60 240	0.40 1	241
Winter	98.10 53	1.90 1	54	96.30 103	2.80 3	106	100 83	0.00 0	83
Total	90.40 584	9.60 62	646	89.90 864	10.1 96	960	99.20 850	0.80 7	857
Chi-Square	19.2			24.8					
p- value	0.000			0.000					

Table 10. Continued

Season	*Salmonella*			Yeast			Moulds		
	(%) Accepted	(%) Not Accept	Total	(%) Accepted	(%) Not Accept	Total	(%) Accepted	(%) Not Accept	Total
Spring	99.60 258	0.40 1	259	84.30 172	15.70 32	204	97.10 198	2.90 6	204
Summer	99.60 251	0.40 1	252	86.20 193	13.80 31	224	100 224	0.00 0	224
Autumn	98.70 234	1.30 3	237	98.90 184	1.10 2	186	99.50 185	0.50 1	186
Winter	100 71	0.00 0	71	93.10 54	6.90 4	58	93.10 54	6.90 4	58
Total	99.40 814	0.60 4	818	89.70 603	10.30 69	672	98.40 661	1.60 11	672
Chi-Square				27.30			17.24		
p- value				0.000			0.001		

4.9. Food Related Diseases in Nablus District.

Data in table (11), (12) and (13) shows the monthly distributions of food related diseases in Nablus district for the years 2003, 2001 and 2000 For the year, 2003 table (11) shows that July, December and August, have the highest number of cases for hepatitis A which were 46, 40 and 39 respectively. While the cases of food poisoning were reported in June and May 25 and 13 respectively. While the high number of reported cases of food related diseases were concentrated in July, August and Jun 52, 50 and 49. For the year 2001, table (12) showed that April, September, and March, have the highest numbers of cases for food poisoning which were 10, 8 and 7 respectively. While the cases of Hepatitis A were reported in August, November and July 32, 30, and 29 respectively .While the high numbers of reported cases of food related diseases were concentrated in July, August and September 35, 37and 37.

For the year 2000, table (13) show that June, August, and March, have the highest number of cases for food poisoning which were 22, 9 and 5 respectively. While the cases of Hepatitis A were reported in February, June, and August 55 ,35, and 34 respectively .While the high number of reported cases of food related diseases were concentrated in June, February, and August 58, 56 and 47.

Table (14) shows the yearly distribution of food related diseases and the cases through the years 2003, 2001, and 2000 in which the total numbers of cases for food poisoning were 59, 43, and 44 respectively. While 355, 310 and 288 of Hepatitis A cases were reported. Also the total number of food related diseases was 420, 354 and 340 in the same years respectively.

CHAPTER FIVE

CHAPTER FIVE

DISCUSSION

5.1 Food Types and Acceptance of Various Microbiological Tests

Data presented in table (4) shows that there is a significant relationship between the sample types and the acceptance of microbiological test TAC (P = 0.00, chi – square = 109.001).

This study indicate that salads have the highest percentages of not accepted samples this is due to poor or inadequate hygienic-conditions during production, transportation, preparations and storage of salads and their constituents. The presence of large numbers of different kinds of bacteria indicates the possibility of food spoilage or food poisoning occurring.

5.1.1 Fruits and Vegetables

In Nablus district, there is no control on the production of both fruits and vegetables, and there are many points at which products can become contaminated with human pathogens. The majority of these pathogens are related to manure through fertilization or irrigation water which is mainly sewage water like Wadi Altufah, Wadi al Zomar in western part of Nablus and Wadi – Al Badan. The contamination depends upon the product type, humidity, and temperature as well as the atmosphere and type of packaging. The source of contamination for raw fruits and vegetables with pathogenic organisms are namely: animals, insects, soil, water, dirty equipments and human handling. For example, according to CDC "fruits flies have been shown to transfer *Escherichia Coli* 0157:H7 to damage apples under laboratory condition" (CDC, 2001).

The transportation of fresh products from production places also plays an important role because of the obstacles imposed by the Israeli Army which places many barriers and checkpoints. This eventually leads to many physical damages to fresh products such as punctures or bruising on the epidermal barriers of fruits and vegetables, this will lead to contamination of fresh fruits and vegetables not to mention the effect of the environmental conditions like temperature and humidity which stimulate the growth and survival of pathogens especially during hot summer months.

5.1.2 Salads

This study shows that salads have the highest percentages of not accepted samples nearly for all the microbiological tests. These findings are in agreement with the current situation of restaurants or food establishments. Poor hygienic practices like preparation of salads with naked hands without any regulations on preparation or refrigeration of salads, which are often left for many hours on show cupboard without any refrigeration or covering. During this period many pathogens can survive and multiply especially if there is no temperature control or bad storage conditions. Such conditions may occur during different incursions or curfew by the Israeli Army in the city. The result of the above-mentioned findings is in agreement with findings in a study conducted by FDA (2001) about the survival of viruses on vegetable salads " Hepatitis A, rotaviruses can survive in a variety of raw vegetables for period exceeding the normal shelf life of salad vegetables, survival appears to be dependent upon the pH , moisture content, and temperature ". These observations indicate that vegetable salads can serve as vehicles for the transmission of viral pathogens to humans. From the findings of this study, the weakness of the sampling system is obviously clear. Through the studied years only 32

samples of salad were tested, taking into account that the number of restaurants in Nablus city is about 228 restaurants in 2004. So, as a conclusion excessive handlings, improper preparation and storage, leads to high unacceptable percentages.

5.1.3 Meats and Diary Products

This study indicates that meats and diary products have high percentages of unacceptable samples tested for TAC and *Salmonella* test, Meat and diary products are very rich media for microbial growth because of this they are immediately contaminated with microorganisms derived from globes, hands, implements used during processing or handlings after processing. In Nablus , the production of diary products like yoghurt and labanh is done at homes manually through many steps giving a chance for mishandling and contamination because the products are handled more often during preparation steps, and uncontrolled transportations. Recently Al-Safa plant began to produce diary products automatically with sterile automatic filling and packages. But still the traditional way is the mostly dominant.

For meats, chickens, and eggs the control on production, transporting, marketing and storage are still limited. The municipality of Nablus controls the slaughtering of live animals in its slaughterhouse after the approval of the veterinary and health doctors, but in the rural areas of Nablus district there is no control over the slaughtering process. For chickens, slaughtering, defeathering and evisceration of the live birds are done in the marketing places. Furthermore eggs are held in poor sanitary and storage conditions for days in the same shops which are mainly used for marketing of chickens. The contamination by Salmonella can be

harmful if meats are eaten raw or partially cooked, so meat should be cooked to reach the temperature of 70C° in deep.

Meats, diary products and salads contain the highest percentages of unacceptable samples with total coliform. This gives a strong indication of fecal contamination due to inadequate processing and cross contamination due to poor hygienic practices of workers through food production chains or water contamination by sewage or contamination with human or animals feces in farms.

Data presented in table(4) showed that there is a significant relationship between the sample and the acceptance of yeast test (p = 0.00, chi-square = 147.462) and the not accepted percentages of meats, cereals, diary products and salads which are 8.8%, 25%, 5.6% ,and 87.1% respectively. Presence of yeast in foods gives an indication of mishandling and inappropriate storage conditions. The growth of yeast gives the products a slimy or cloudy appearance by creating metabolic byproducts especially through fermentation. (Kuntz, 1996).

Data presented in table (4) shows that there is a significant relationship between the sample and the acceptance of Moulds test (p = 0.00, chi-square = 35.685). The not accepted percentage of cereals by moulds was high (25%).

Cereals contamination by moulds is due to bad storage conditions with high moisture and temperatures inside the stores or shops, especially in the old city of Nablus.

Grains, vegetables and fruits are susceptible to mould contamination prior to harvesting and during storage.

5.2 Acceptance of Sample Sources and Various Microbiological Tests.

5.2.1 Restaurants

This study showed that restaurants in Nablus are suffering from high level of contamination, bad conditions, and poor hygienic practices for the following reasons:-

1- Economic status reduces the ability of the owners of restaurants to have a suitable clean water source and a reasonable bathroom with hygienic properties and proper sewage disposal.

2- Lack of experience because the employers change the workers many times to reduce the costs and some other time the workers themselves quit the job if they get a better salary in another place.

3- Hand washing soaps for use by workers and customers are not available in most restaurants and sweet shops" (Al –Khatib et.al., 2004).

4- Unawareness of the importance of good hygienic practices like hand washing and the cleaning of preparation surfaces with hot water and soaps especially in kitchens of the restaurants where a large number of workers lack knowledge about importance of hygienic practices and awareness of the cleanliness of preparing surfaces and dishes

5- Ignorance of the importance of wearing clean uniforms while on duty as, gloves, head cover, and proper shoes.

6- Lack of knowledge about the importance of health education and personal hygiene by the employees.

In Nablus city, there are 228 restaurants and 45 sweet shops. These restaurants serve all types of foods both popular and regular, but their work was negatively affected by Intefada, but on the other hand, their work improved because of Siege and the closure of the city by Israeli Army. As a result, many of the students at An-Najah National University were forced to live in Nablus. (An-Najah National University is the largest University in West Bank). So many students go to eat in these restaurants.

The last findings are in agreement with the findings of CDC and Hall "That the recent data indicate that 80% of reported foodborne diseases occur outside home". (CDC, 1996).

"Also approximately 85% of all out breaks occur as result of food mishandling in food services establishments or homes " (Hall, 1999). As conclusion "kitchen facilities need to be routinely inspected to ensure they are sanitary as such steps should go hand in hand with sampling and testing of foods"

5.2.2 Food Factories: -

Food factories the next after restraints in regard to the percentages an accepted samples. From the findings the percentage of not accepted samples is 6(2.3%) out of 251 samples for TAC test, and for TC, 11(3.6%) out of 270 samples. For *Salmonella* test one sample out of 263 samples was not accepted. Hence, the presence of any *Salmonella* serotype in any food should be regarded as a potential hazard. This could be considered as an indication of cross contamination or that the foods originally contain the disease. In Nablus district, there is an increase in the number of food industries and food processing institutions; as an example in 1995 there were 125 food institutions, but until July/2004 there are 187 food

institutions (Nablus Chamber of Commerce and Industry. 2004). On the other hand, the number of tested samples doesn't parallel with this increase. Contamination of food industry is caused mainly by diary products which is always sold by hawkers from rural areas, and are not controlled very well during processing and transportation. Meat industry can be contaminated if the cooking temperatures, personal hygiene, cutting and packaging are not controlled.

5.3 Acceptance of Cooked Samples and Various Microbiological Tests.

What is considered a cooked sample is the canned or pasteurized**.** This study showed that cooked samples have a lower percentage of not accepted samples than uncooked ones. The unacceptable percentage of cooked samples might be attributed to inadequate processing, or post – process recontamination or cross contamination and /or improper handling after processing. Generally speaking cooking and canning destroy pathogenic organisms beside the desirable effects of cooking like increasing the protein digestibility, destroying antinutrients, and removing natural toxicants as cyanide, (Hall, 1999).

The number of not accepted cooked samples tested for *S. aureus* test were 5 (0.9%) out of 566 whereas and for uncooked 2 samples (1.1 %) out of 188 samples were not accepted. This in agreement with the fact that *Staphylococcus aureus* doesn't grow well in competition with other organisms'. Accordingly it is rarely found in unprocessed foods since it grows better in foods after cooking. Therefore, *Staph*. is easily destroyed by heat treatment.

5 .4 Acceptance and Distributions of Food Samples by Month, Season, and Years.

5.4.1 Distribution of Samples during Studied Years.

Table (9) presents the findings of various microbiological tests for the years 1995, 1997, 1999, 2002, 2003 which were 4, 97, 231, 102and 562 respectively for TC test . From the findings, the distribution of sampling regimes is not systematic, in 1995; only 4 samples were tested while in 2003 there were 566 samples. So the current sampling system reflects the weakness of sampling system which doesn't reach a satisfactory level to show the situation of food safety or the degree of food contamination in Nablus district. Since the purpose of food sampling programs is to detect food contaminants before they are sold to the public (Wong, 2004). From the results the highest number of samples was in 2003, and this is attributed to the increase in number of inspectors and most of their works are concentrated in Nablus city.

5.4.2 Distribution of Samples through the Different Seasons.

This study showed that there are high percentages of not accepted samples in summer and spring and this is due to high temperatures and increased consumption of fruit juices or vegetable salads. The temperature degrees in Nablus district varies greatly between Summer months and winter months as an examples the average maximum temperatures in July and August; which are the hottest months for the years 1997, 1998, 1999, 2000, 2001, and 2003 are 345c° 33.75c° respectively and the average minimum temperatures are 18.7c° and 19.2c ° for the same mentioned months respectively. While in Winter the coldest months are December and January, the average minimum temperatures are 4.5c° and 2.6c° are respectively for the same mentioned years (PMD, 2004), as result of hot climates in Summer season the optimum growth temperature for various

microorganisms are available e.g. the optimum growth temperatures for *Salmonella* is 6.5- 47c̊ , *C. botulinum* is 10-50c̊ , *E.coli* is 2.5-45c̊ (CDC. 1999) so if the foods stay in these temperatures pathogens multiply rapidly and can produce toxins; as result of this proper storage and refrigeration of foods is required especially during hot summer months.

5.4.3 Distribution of Samples through the Different Months.

Table (8) shows the monthly distribution of sampling and not accepted percentages and numbers of samples. The majority of microbiological tests were taken in September, December, April, July, and May and the numbers of samples are 111, 125, 102, and 96 and 86 respectively. But the months with high not accepted percentages are July and August and the not accepted percentages are 28.6% and 15.2% for TAC test while the not accepted percentages are 22.1% and 18.5% in May and August for TC test .For Yeast test 30.5% and 28.6% of not accepted samples were in May and July, so from the last findings the months with high not accepted percentages are in Spring and Summer months when the temperature is high. In the years 1998, 1999, and 2000, the maximum temperature was 37.5 C̊ in May, August, and September according to the Palestinian Meteorology Department. This finding correlates significantly with the fact that the contamination percentages are increased by increasing the temperature. Hot Summer temperatures can help the foodborne bacteria multiply at a rapid rate, spoiling food and causing illness .In addition the movement of people and cars often increases during Summer, and this will boost the contamination of air, dust, sand, and soil.

Conclusion:

People have the right to consume safe and suitable food. To achieve this end, food control becomes an urgent need to guarantee that the food which is offered to consumers is safe, wholesome, and of expected quality. Microbial quality is the crux of this thesis. The results of this study showed that:

- The Highest percentages of not accepted samples tested for TAC, TC, Yeast and Moulds were for salads, meats and chickens, and diary products samples respectivy.

- Restaurants have the highest numbers of unaccepted samples tested for TAC, TC, Yeast and Moulds.

- The sampling system during months, seasons, and years are not rational and unsystematic. Hence, a defined number of samples during months or years deemed vital.

The current situation of high levels of food contaminations is the result of:

1. Absence of regulations and guidelines for food control and handlings especially in restaurants and food factories.

2. Existence of unsystematic food sampling and absence of regular sampling schedules.

3. The political and economical situation restricts the efforts of MOH and other involved institutions to take action.

4. Absence of clear lines of authority or overlapping between different governmental organizations, agencies and other sectors causing wastage of limited existing resources.

Recommendations

This study recommends the following measures:

1. Health education for food handlers about food safety.
2. Holding educational programs for public to protect them during the handling, preparation, serving, and storage of food.
3. Establishing committee to monitor food safety.
4. Increasing the number of trained food inspectors.
5. Increasing the number of analytical services.
6. Adopting Hazard analysis critical control point (HACCP) in the concerned establishments.
7. Supporting and encouraging scientific research about food safety.

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APPENDIXES

Appendix A

Table A-1. Food processing institutions

Year	Numbers
Before 1995	99
1995	125
1996	133
1997	138
1998	154
1999	161
2000	170
2001	176
2002	178
2003	185
11/7/2004	187

Source: Nablus chamber for commerce and industry (2004).

Table B-2. Foods and drinks commerce in Nablus district.

Year	Numbers
Before 1995	115
1995	161
1996	186
1997	203
1998	229
1999	245
2000	262
2001	279
2002	295
2003	315
11/7/2004	334

Source: Nablus chamber for commerce and industry (2004).

Food storing services

1. Since 1962 until now (Food storing; oils, pickles, cheese).
2. Since 1985 until now (Freezing & refrigeration's for all food items)

Source: Nablus chamber for commerce and industry (2004).

In Nablus:

1. 228 Restaurants.
2. 45 Sweet Factories

Source: Nablus municipality (2004).

Appendix C.

Table B _1. Seasons and the acceptance the microbiological tests for diary products

	TAC					TC					SA				
season	accept	% accept	Not accept	not % accept	Total	ptacce	% accept	Not accept	not % accept	Total	accept	% accept	Not accept	not % accept	Total
spring	35	97.2	1	2.8	36	33	84.6	6	15.4	39	44	91.7	4	8.3	48
summer	88	91.7	8	8.3	96	90	90.9	9	9.1	99	101	99.0	1	1.0	102
autumn	33	97.1	1	2.9	34	39	88.6	5	11.4	44	44	100.0	-	-	44
winter	12	100.0	-	-	12	11	91.7	1	8.3	12	13	100.0	-	-	13
total	168	94.4	10	5.6	178	173	89.2	21	10.8	194	202	97.6	5	2.4	207
											Chi –square		9.434		
											P - value		0.024		

Table B-1. Continued

	Salmonella					**Yeast**					**Moulds**				
season	accept	% accept	Not accept	not % accept	Total	accept	% accept	Not ccepta	not % accept	Total	accept	% accept	Not accept	not % accept	Total
spring	48	100.0	-	-	48	38	92.7	3	7.3	41	39	95.1	2	4.9	41
summer	101	99.0	-	-	101	96	96.0	4	4.0	100	100	100.0	-	-	100
autumn	43	100.0	-	-	43	40	95.2	2	4.8	42	42	100.0	-	-	42
winter	13	100.0	--	-	13	12	92.3	1	7.7	13	12	92.3	1	7.7	13
Total	205	99.5	-	-	205	186	94.9	10	5.1	196	193	98.5	3	1.5	196
											Chi –square		8.530		
											P - value		0.036		

Table B-2. Year and Acceptance Various Microbiological Tests for Meat and Chickens.

	TAC					TC					SA				
YEAR	accept	% accept	Not accept	not % accept	Total	accept	% accept	Not accept	not % accept	Total	accept	% accept	Not accept	not % accept	Total
1995	-	-	-	-	-	4	100.0	-	-	4	4	100.0	-	-	4
1997	-	-	-	-	-	25	80.6	5	14.9	30	30	96.8	1	3.2	31
1999	-	-	-	-	-	72	94.7	4	5.3	76	74	100.0	-	-	74
2002	16	88.9	2	11.1	18	18	100.0	-	-	18	18	100.0	-	-	18
2003	33	84.0	6	15.4	39	36	92.3	3	7.7	39	39	100.0	-	-	39
Total	49	86.0	8	14.0	57	155	92.3	13	7.7	168	156	99.0	1	0.6	157

Table B-2. continued

	Salmonella					Yeast					Moulds				
YEAR	accept	% accept	Not accept	Total	not % accept	accept	% accept	Not accept	not % accept	Total	accept	% accept	Not accept	not % accept	Total
1995	4	100.0	-	4	-	-	-	-	-	-	-	-	-	-	-
1997	27	90.0	3	27	10.0	-	-	-	-	-	-	-	-	-	-
1999	71	100.0	-	71	-	-	-	-	-	-	-	-	-	-	-
2002	18	100.0	-	18	-	18	100.0	-	-	18	18	100.0	-	-	18
2003	38	97.4	1	39	2.6	34	87.2	5	12.8	39	39	100.0	-	-	39
total	158	97.5	4	162	2.5	52	91.2	5	8/8	57	57	100.0	-	-	57
	Chi- square-		9.52												
	p- value		0.05												

Table B-3. Year and The acceptance the microbiological tests for diary products.

	TAC					TC					SA				
YEAR	accept	% accept	Not accept		not % accept	accept	% accept	Not accept		not % accept	accept	% accept	Not accept		not % accept
1995	-	-	-		-	-	-	-		-	-	-	-		-
1997	-	-	-		-	1	100.0	-		-	1	100.0	-		-
1999	-	-	-		-	1	100.0	-		-	9	69.2	4		30.8
2002	13	92.9	1		7.1	12	80.0	3		20.0	16	100.0	-		-
2003	155	94.5	9		5.5	159	89.8	18		10.2	176	99.4	1		0.6
Total	168	94.4	10		5.6	173	89.2	21		10.8	202	97.6	5		2.4
											Chi -square		47.331		
											P -value		0.000		

Table B-3.continued

	Salmonella					**Yeast**					**Moulds**				
YEAR	accept	% accept	Not accept	not % accept	Total	accept	% accept	Not accept	not % accept	Total	accept	% accept	Not accept	not % accept	Total
1995	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1997	1	100.0	-	-	1	-	-	-	-	-	-	-	-	-	-
1999	12	100.0	-	-	12	-	-	3	100.0	3	-	-	3	100.0	3
2002	15	93.8	-	-	15	12	75.0	4	25.0	16	15	100.0	-	-	15
2003	177	100.0	-	-	177	174	98.3	3	1.7	177	177	100.0	-	-	177
Total	205	99.5	-	-	205	186	94.9	10	5.1	196	193	98.5	3	1.5	196
	Chi -square		11.933			73.128									
	P -value		0.008			0.000									

Table B-4.Using of preservatives and acceptance various microbiological tests for meat and chickens.

	TAC					TC					SA				
	accept	% eptacc	Not accept	not % accept	Total	accept	% accept	Not accept	not % accept	Total	accept	% accept	Not accept	not % accept	Total
With preservatives	-	-	-	-	-	1	100.0	-	-	-	1	100.0	-	-	1-
Without preservatives	49	86.0	8	14.0	57	154	92.2	13	7.8	167	164	99.4	1	0.6	165
Total	49	86.0	8	14.0	57	155	92.3	13	7.7	168	165	99.4	1	0.6	166

Table B-4. continued

	Salmonella					**yeast**					**Moulds**				
	accept	% accept	Not accept	not % accept	Total	accept	% accept	Not accept	not % accept	Total	accept	% accept	Not accept	not % accept	Total
With preservatives	1	100.0	-	-	1	-	-	-	-	-	-	-	-	-	-
hout Wit preservatives	157	97.5	4	2.5	161	52	91.2	5	8.8	57	57	100.0	-	-	57
Total	158	97.5	4	2.5	162	52	91.2	5	8.8	57	57	100.0	-	-	57

Table C-5. Using of preservatives and acceptance various microbiological tests for diary products.

	TAC					TC					SA				
	accept	% accept	Not accept	not % accept		accept	% accept	Not ptacce	not % accept		accept	% accept	Not accept	not % accept	
withpreservatives	-	-	-	-		-	-	-	-		-	-	-	-	
withoutpreservatives	168	94.4	10	5.6		173	89.2	21	10.8		202	97.6	5	2.4	
Total	168	94.4	10	5.6		173	89.2	21	10.8		202	97.6	5	2.4	

Table C-5. Continued

	Salmonella					Yeast					Moulds				
	accept	% accept	Not accept	not % accept	Total	accept	% accept	Not accept	not % accept	Total	accept	% accept	Not accept	not % accept	Total
With preservatives	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Without preservatives	205	99.5	-	-	205	186	94.9	10	5.1	196	193	98.5	3	1.5	196
Total	205	99.5	-	-	205	186	94.9	10	5.1	196	193	98.5	3	1.5	196

Table B-6. Cooked and uncooked samples and acceptance various microbiological tests for Meats and chickens.

	TAC					TC					SA				
	accept	% accept	Not accept	not % accept	Total	accept	% accept	Not accept	not % accept	Total	accept	% accept	t No accept	not % accept	Total
Cooked	42	91.3	4	8.7	46	74	94.9	4	5.1	79	78	100.0	-	-	78
Uncooked	7	87.5	1	12.5	8	79	90.8	8	9.2	87	84	98.8	1	1.2	85
Other	-	-	3	100.0	3	2	66.7	1	33.3	3	3	100.0	-	-	3
Total	49	86.0	8	14.0	47	155	92.3	13	7.7	168	165	99.4	1	0.6	166
	Chi- square		19.478												
	P -value		0.000												

Table B-5. Continued

	onellaSalm					**Yeast**					**Moulds**				
	accept	% accept	Not accept	not % accept	Total	accept	% accept	Not accept	not % accept	total	accept	% accept	Not accept	not % accept	Total
Cooked	74	98.7	1	1.3	75	42	91.3	4	8.7	46	46	100.0	-	-	46
Uncooked	81	96.4	3	3.6	84	8	100.0	-	-	8	8	100.0	-	-	8
Other	**3**	**100.0**	-	-	3	2	**66.7**	**1**	**33.3**	**3**	**3**	**100.0**	**-**	**-**	**3**
Total	158	97.5	4	2.5	162	52	91.2	**5**	**8.8**	**57**	**57**	**100.0**	**-**	**-**	**57**

Table B- 6 Cooked and uncooked samples and acceptance various microbiological tests for diary products

	TAC					TC					SA				
	accept	% accept	Not accept	not % accept	Total	accept	% accept	Not accept	not % accept	Total	accept	% accept	Not accept	not % accept	Total
Cooked	142	93.4	10	6.6	152	146	87.4	21	12.6	167	175	97.2	5	2.8	180
Uncooked	3	100.0	-	-	3	3	100.0	-	-	3	3	100.0	-	-	3
Other	23	100.0	-	-	23	24	100.0	-	-	24	24	100.0	-	-	24
Total	168	94.4	10	5.6	178	173	89.2	21	10.8	194	202	97.6	5	2.4	207

Table B-6. Continued

	Salmonella					Yeast					Moulds				
	accept	% accept	Not accept	not % accept	Total	accept	% accept	Not accept	not % accept	Total	accept	% accept	Not accept	not % accept	Total
Cooked	178	99.4	-	-	178	159	94.1	10	5.4	169	166	98.2	3	1.8	169
Uncooked	3	100.0	-	-	3	3	100.0	-	-	3	3	100.0	-	-	3
Other	**24**	**100.0**	**-**	**-**	**24**	**24**	**100.0**	**-**	**-**	**24**	**24**	**100.0**	**-**	**-**	**24**
Total	**205**	**99.5**	**-**	**-**	**205**	**186**	**94.9**	**10**	**5.1**	**196**	**193**	**98.5**	**3**	**1.5**	**196**

Table B-7. Monthly distribution of samples and acceptance various microbiological tests for meat and chickens .

	TAC					TC					SA				
Month	accept	% accept	Not accept	not % accept	Total	accept	% accept	Not accept	not % accept	Total	accept	% accept	Not accept	not % accept	Total
January	6	85.0	1	14.3	7	8	88.9	1	11.1	9	9	100.0	-	-	9
February	-	-	-	-	-	13	100.0	1	7.1	14	14	100.0	-	-	14
March	7	87.5	1	12.5	8	16	94.4	1	5.9	17	18	100.0	-	--	18
April	4	100.0	-	-	4	15	83.3	3	16.7	18	18	100.0	-	-	18
May	3	100.0	-	-	3	9	100.0	-	-	9	8	100.0	-	-	8
June	8	80.0	2	20.0	10	13	92.9	1	7.1	14	14	100.0	-	-	14
July	3	75.0	1	25.0	4	13	100.0	-	-	13	13	100.0	-	-	13
August	2	50.0	2	50.0	4	9	100.0	-	-	9	9	100.0	-	-	9
September	6	100.0	-	-	6	10	90.9	1	9.1	11	11	100.0	-	-	11
October	5	83.0	1	16.7	6	17	85.0	3	15	20	17	94.4	1	5.6	17
November	1	100.0	-	-	1	16	100.0	-	-	16	16	100.0	-	-	16
December	4	100.0	-	-	4	16	88.9	2	11.1	18	18	100.0	-	-	18
Total	49	86.0	8	14.0	57	155	92.3	13	7.7	168	165	99.4	1	60.	166

Table B-7.continued

	Salmonella					Yeast					Moulds				
Month	accept	% accept	Not accept	not % accept	Total	accept	% accept	Not accept	not % accept	Total	accept	% accept	Not accept	not % accept	total
January	9	100.0	-	-	9	7	100	-	-	7	7	100.0	-	-	7
February	13	100.0	-	-	13	-	-	-	-	-	-	-	-	-	-
March	17	100.0	-	-	17	7	87.5	1	12.5	8	8	100.0	-	-	8
April	18	94.4	1	5.6	19	1	25.0	3	75.0	4	4	100.0	-	-	4
May	8	100.0	-	-	8	3	100.0	-	-	3	3	100.0	-	-	3
June	14	100.0	-	-	14	10	100.0	-	-	10	10	100.0	-	-	10
July	13	100.0	-	-	13	4	100.0	-	-	4	4	100.0	-	-	4
August	9	100.0	-	--	9	3	75.0	1	25.0	4	4	100.0	-	-	4
September	11	100.0	-	-	11	6	100.0	-	-	6	6	100.0	-	-	6
October	16	98.9	2	11.1	16	6	100.0	-	-	6	6	100.0	-	-	6
November	16	100.0	-	-	16	1	100.0	-	-	1	1	100.0	-	-	1
December	14	93.3	1	6.7	15	4	100.0	-	-	4	4	100.0	-	-	1
Total	158	97.5	4	2.5	162	52	91.0	5	8.80	57	57	100.0	-	-	57
						Chi – square		27.322							
						P – value		0.002							

Table B-8. Monthly distributions of samples and acceptance various microbiological tests for diary products .

	TAC					TC					SA				
Month	accept	% accept	Not accept	not % accept	Total	accept	% accept	Not accept	t no% accept	total	accept	% accept	Not accept	not % accept	total
January	7	100.0	-	-	7	6	85.7	1	14.3	7	8	100.0	-	-	8
February	5	100.0	-	-	5	5	100.0	-	-	5	5	100.0	-	-	5
March	5	100.0	--	-	5	5	100.0	-	-	5	8	100.0	-	-	8
April	8	100.0	-	-	8	8	88.1	1	11.1	9	8	80.0	2	20.0	8
May	15	100.0	-	-	15	15	88.2	2	11.8	17	20	90.9	2	9.1	22
June	7	87.5	1	12.5	8	5	62.5	3	37.5	8	8	100.0	-	-	8
July	18	94.7	1	5.3	19	18	94.7	1	5.3	19	20	100.0	-	-	20
August	9	90.0	1	10.0	10	9	81.8	2	18.2	11	12	92.3	1	7.7	13
September	61	91.0	6	9.0	67	63	91.3	6	8.7	69	69	100.0	-	-	69
October	6	85.7	1	14.3	7	9	81.3	2	18.2	11	9	100.0	-	-	9
November	3	100.0	-	-	3	5	71.4	2	28.6	7	8	100.0	-	-	8
December	24	100.0	-	-	24	25	96.2	1	3.8	26	27	100.0	-	-	27
Total	168	94.4	10	5.6	178	173	89.2	21	10.8	194	202	97.6	5	2.4	207
											Chi-square		22.823		
											P - value		0.019		

Table B-8. Continued

Month	*ImonellSaa*					Yeast					Moulds				
	accept	% accept	Not accept	not % accept	Total	accept	% accept	Not accept	not % accept	Total	accept	% accept	Not accept	not % accept	total
January	8	100.0	-	-	8	7	100.0	-	-	7	7	100.0	-	-	7
February	5	100.0	-	-	5	5	83.3	1	16.7	6	5	83.3	1	16.7	6
March	8	100.0	-	-	8	5	100.0	-	-	5	5	100.0	-	-	5
April	10	100.0	-	-	10	9	81.8	2	18.2	11	9	81.8	2	18.2	11
May	22	100.0	-	-	22	16	94.1	1	5.9	17	17	100.0	-	-	17
June	8	100.0	-	-	8	8	100.0	-	-	8	8	100.0	-	-	8
July	20	100.0	-	-	20	18	94.7	1	5.3	19	19	100.0	-	-	19
August	12	100.0	-	-	12	10	83.3	2	16.7	12	12	100.0	-	-	12
September	69	100.0	-	-	69	68	98.6	1	1.4	69	69	100.0	--	-	69
October	9	100.0	-	-	9	8	88.9	1	11.1	9	9	100.0	-	-	9
November	8	100.0	-	-	8	6	85.7	1	14.3	7	7	100.0	-	-	7
December	26	100.0	-	-	26	26	100.0	-	-	26	26	100.0	-	-	26
Total	205	100.0	-	-	205	186	94.9	10	5.1	196	193	98.5	3	1.5	193
											Chi-square		32.138		
											P - value		010.0		

بسم الله الرحمن الرحيم

جامعة النجاح الوطنية
كلية الدراسات العليا

تقييم الجودة الميكروبية للأغذية في محافظة نابلس

إعداد
أمية مرشد محمد حماد

إشراف
الدكتور يحيى فيضي
الدكتور عصام الخطيب

قدمت هذه الأطروحة استكمالاً لمتطلبات درجة الماجستير في الصحة العامة بكلية الدراسات العليا في جامعة النجاح الوطنية في نابلس، فلسطين.
2004

تقييم الجودة الميكروبية للأغذية

في محافظة نابلس

إعداد

أمية مرشد محمد حماد

إشراف

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الدكتور عصام الخطيب

الملخص

أجريت هذه الدراسة بهدف معرفة الجوده الميكروبية ونسب تلوث العينات الغذائية التي جمعت في الفتره الواقعه من 1995– 2003 من قبل قسم صحة البيئه في محافظة نابلس. وقد أخذت هذه العينات من سجلات مديرية صحة محافظة نابلس. وقد تمت معالجة هذه العينات بواسطة برنامج SPSS. وقد تم تقسيم العينات بناءاُ على عدة متغيرات مثل نوع العينه ، مصدر العينة، حالة العينة (مطبوخة او غير مطبوخة) وأ يضا الشهر، أو الفصل، أو السنة التي جمعت فيها العينات . بالنسبة لنوع العينه، فإن عينات السلطة، واللحوم، والدواجن، ومنتجات الألبان احتلت أعلى نسبة من العينات غيرالمقبوله بالنسبه لفحص العد البكتيري الكلي تبعا للمواصفات والمعايير الفلسطينية وقد وجد ان هناك علاقة ذات دلالة احصائية بينه وبين عينات السلطه واللحوم والدواجن ومنتجات الحليب حيث كانت نسب التلوث على التوالي (62.1%) ، (14%) و(5.5%) على التوالي.

وقد بينت هذه الدراسه ايضاً ان اعلى نسيه للعينات غير المقبوله هي تلك التي اخذت من المطاعم بالنسبه للفحوصات التاليه (العد البكتيري الكلي وبكتيريا القولونيات والسالمونيلا والخميره والفطريات). حيث كانت هذه النسب (56.9%) و(65.6%) و(75.9%) و(3%) على التوالي.

أما بالنسبه لمتغير السنوات فإن عدد العينات متباين خلال السنوات التي اشتملت عليهـــا الدراسة، فقد كانت أعلى نسبة في عام ،2003 حيث بلغ عدد العينات 562 ، أما في عام 1995 فقد بلغ عدد العينات 4 عينات فقط.