MICROBIOLOGICAL QUALITY AND SAFETY OF PERISHABLE FOOD SOLD BY TAKE-AWAY FOOD OUTLETS IN THE CENTRAL OPERATIONAL ENTITY OF ETHEKWINI MUNICIPALITY - DURBAN

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ABSTRACT

One hundred take-away food outlets within the Central Operational Entity of eThekwini Municipality were investigated in order to assess the microbiological quality and safety of perishable food sold as well as the level of hygiene conditions under which these food shops operate. This cross sectional observational and descriptive study was conducted between August and September 2005 with the overall aim to improve the delivery of safe food, promote good hygiene practices from take-away food outlets and target interventions that will assist improvements of service delivery in the food control section of eThekwini Municipality Health Department.

Ready-to-eat foods which were collected included salads, beef, chicken and chips to determine actual microbiological quality of these products. Food temperatures were recorded at the time of sampling. Premises were inspected by the team of trained Environmental Health Practitioners who used pre-structured checklist forms to determine the status food preparation areas and associated food handling practices. Standard methods were used to determine total bacteria count, coliform count, *Escherichia coli, Staphylococcus aureus* and *Salmonella*.

The overall microbiological quality of the food served by the take-away food outlets were found within acceptable safety limits. *Escherichia coli, Staphylococcus aureus* and *Salmonella* were evaluated and no incidence of these organisms was detected in all the food products sampled. 76% of samples showed high total bacteria count and coliforms were detected in 50% of food products.

The results of the study indicate that there are some handling practices in the preparation process of ready- to-eat food that require more attention. In particular, control in food handling needs to be observed by food handlers as a result of significant incident of a high total bacteria count. There was a lack of correlation between bacterial count and the observed cleanliness of preparation areas and food handling practices.

It is recommended that eThekwini Municipality Health Department embarks on a health education campaign on food safety. Food handlers should receive training and education in two aspects of food safety; namely, principles of good hygiene practice and the application of the Hazard Analysis and Critical Control Point concept to food preparation.

DECLARATION

The research work described in this dissertation was carried out in the eThekwini Municipality Central Operational Entity, Durban, from August to September 2005, under the supervision of Professor N. Gqaleni (University of KwaZulu-Natal).

This study represents original work by author and has not otherwise been submitted in any form for any degree or diploma to any tertiary institution. Where use has been made of work of others it has been duly acknowledged in the text.

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ACRONYMS AND ABBREVIATIONS

APZ	Analytical Profile Index
BPLS	Brilliant Green Phenol Red Lactose Sucrose
CC	Coliform Count
DSW	Durban Solid Waste Department
E. coli	*Escherichia coli*
EHP's	Environmental Health Practitioners
EMA	eThekwini Municipality Area
FCD Act	Food, Cosmetics and Disinfectant Act, 1972 (Act 54 of 1972)
PCA	Plate Count Agar
HACCP	Hazard Analysis and Critical Control Point
RTE	Ready-to-eat
RVS	Rappaport vassiliadis Medium
S. aureus	*Staphylococcus aureus*
SCB	Selenite Cysteine Broth
VRBA	Violet Red Bile Agar
XLD	Xylose Lysine Deoxycholate

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PREFACE

"If food hygiene is intended to prevent food poisoning then it follows that hygiene is more than cleanliness, it involves all measures necessary to ensure the safety and wholesomeness of food during preparation / processing, manufacture, storage, transportation, distribution, handling, sale and supply."

Sprenger, 1999

CHAPTER 1:INTRODUCTION

1.1 INTRODUCTION

As urbanization has advanced in developing countries and more people have moved to the cities, new eating habits have emerged among the urban population. This has contributed to the increasing number of take-away food outlets and emerging food-borne diseases.

Food-borne disease is a significant and increasing public health problem world wide and cuts across national boundaries. In terms of human illness and economic loss the costs can be immense. Worldwide incidence of food-borne disease has increased and data suggest that inadequate food handling behaviour in food shops may be an important factor.[1]

Controversy about the safety of food has had a huge impact on the food industry in many countries. Unsafe food has to be withdrawn from sale and destroyed, and adverse publicity can lead to further economic loss, closure of outlets, lawsuits and prosecution.[1]

The causative agents are mostly harmful microorganisms. The increase in food borne illness world wide is linked to the way consumers choose, handle and store food .[1] In the USA, 90% of outbreaks of food poisoning are attributed to mishandling of food in the food service sector and in the home.[2]

1.2 THE SETTING

The eThekwini Municipality Area (EMA) is located on the eastern seaboard within the Province of KwaZulu-Natal and covers an area of 2297 square kilometers. While the total of EMA makes 1, 4% of the total area of the province it contains just over a third of the population of KwaZulu-Natal and 60% of its economic activity [3] Only 35% of the EMA is predominantly urban in character, with over 80% of the population living in these areas. The EMA currently has an estimated population of just over 3 million.[3]

This study was conducted in 100 take-away food outlets within the Central Operational Entity of eThekwini Municipality, Durban, in the province of KwaZulu-Natal, South Africa. Durban is situated at 31°00'E: 29°5O'S.[3] It is a coastal city with warm tropical current flowing down the coast.[3] Annexure 1 is the map showing where the study was conducted in relation to the EMA.

1.3 BACKGROUND TO THE RESEARCH AND PROBLEM STATEMENT

1.3.1 Background to the research

Contaminated food and water have been known to be sources of illness in human societies since antiquity. Food-borne diseases are still among the most widespread health problems in the

contemporary world. In rich and poor countries alike, they impose substantial health burden, ranging in severity from mild indisposition to fatal illnesses. Food safety is an increasingly important public health issue and according to the WHO, governments all over the world are intensifying their efforts to improve food safety[4]. This is largely due to rapid globalisation and the emphasis placed on and the interest shown in the importance of the safety of food crossing national boundaries in international trade. Together with this, there has been a dramatic increase in the number of people travelling internationally for, amongst others, tourism and business purposes, including the attendance of special events such as sport, cultural and others.[4]

Most food-borne disease results from inappropriate food hygiene and food handling practices, which could be avoided. Other factors influencing the increase of food-borne illness worldwide include the emergence of new and virulent strains of pathogens, the increased consumption of and consumer preference for, fresh, minimally processed food, take-away and ready-to-heat meals, changes in animal husbandry, and the increase in the proportion of elderly and other at-risk groups.[5]

The WHO defines 'Food Safety' as the assurance that food will not cause harm to the consumer when prepared and/or eaten in accordance with its intended use. Furthermore 'Food Hygiene' is defined, as all the measures necessary to ensure the safety, soundness and wholesomeness of food at all stages from its production or manufacture until its final consumption.[4]

In the developing world the WHO estimates that 2 million children die each year from diarrheal diseases, which are transferred from water and contaminated food.[4] Although South Africa is considered a developing country, the food industry of the country can be considered as a well developed and sophisticated sector, geared towards providing the needs of consumers through both the formal and informal sectors of the country's economy. From food production on the farm, to further processing at factory level, through to retail level, both as foodstuffs offered for sale to consumers at outlets such as supermarkets or shops (spaza shops- within disadvantaged communities), or further prepared as ready-to-eat meals by catering facilities such as restaurants, fast food outlets, street food vendors, etc.; legislation exists aimed at ensuring that all foodstuffs and food handling facilities comply to health standards aimed at protecting consumers from unsafe food and food prepared under unhygienic conditions.[4]

Food safety, particularly in relation to its microbiological quality, has become a major issue worldwide. Food-associated disease caused by food-poisoning bacteria has a huge economic and human consequence. It is unrealistic to expect that such pathogens, which are widespread in the environment, animals and man, can be excluded completely from all stages of the food chain. However, this does not remove the obligation on everyone handling food to ensure that food is of the highest microbiological quality and safe for human consumption.[5]

The purpose of this study was to provide knowledge that could be used to improve the delivery of safe food, promote good hygiene practices and target interventions and overall assist in improving service delivery in the food control section of EMHD.

1.3.2 The overall problem

The dynamic shifts taking place in the patterns of disease require a capability to monitor change and target interventions for the highest priority problem. According to the eThekwini Municipality Health Department's statistics over the past 5 years, reported cases of food-borne diseases are low. This makes one suspicious whether this means that the food outlets of the Durban area are doing a good job out or that cases are not being reported. Between 1993 and 2003 out of 340 food related complaints received by this department only 10% were related to food poisoning.[6] This number represents reported information only. The eThekwini Municipality Health Department actually has no idea how many people get sick from eating contaminated foods. Most people with gastro-intestinal upsets do not consult a doctor or visit a health centre. [7] If they do, particularly with diarrhoea and vomiting, they may not often be tested for the presence of food-borne pathogens. Out of the reported cases, 90% of these food related complaints are associated with food purchased from the take-away food outlets.[6] Complaints will vary, for example, most complaints relate to people having stomach pains, some vomiting and some with diarrhoea after consuming food purchased from a certain take-away food outlet.[6]

1.3.3 The specific problem that was to be researched

It is not well known what the microbiological quality of food and the safe handling practices in the take away food outlets of the Central Operational Entity of eThekwini Municipality, (Durban).

1.4 AIM OF THE STUDY

To determine the microbiological quality of food and the safe handling thereof in selected take-away food outlets of the Central Operational Entity of eThekwini Municipality, (Durban).

1.5 SPECIFIC OBJECTIVES

The primary objectives of the study were to conduct a survey of selected take-away food outlets in the Central Operational Entity of eThekwini Municipality (Durban) to assess:

- The state of hygiene of food premises.
- Safety practices of food handlers.
- Bacterial quality of ready-to-eat food.

The secondary objectives of the study were to assess:

- The relationship between the state of hygiene of the food premises and the bacterial quality of the food, and

- The association between the food safety practices of food handlers and the bacterial quality of the food.

1.6 HYPOTHESES

For the three primary objectives, research was exploratory and not hypothesis-testing. The secondary objectives tested the hypotheses that there is an association between:

- State of hygiene of the food premises and the bacterial quality of the food.
- Food safety practices of food handlers and the bacterial quality of the food.

1.7 SCOPE OF THE STUDY

Many food outlets sell perishable food to the public within the eThekwini Municipality Area (EMA). The type of food outlets included restaurants, canteens and street vendors. This study concentrated on those dealing in ready-to-eat take-away food outlets only.

1.8 STRUCTURE OF THIS REPORT

- Chapter 1 outlines a general introduction, the background of the research study, the statement of the problem and the objectives of the study;
- Chapter 2 is a review of the literature. This section reviews hygiene in food preparation areas, microorganisms and food safety, the South African legislation relating to food safety, the roles and responsibilities of the health system regarding food safety and the Hazard Analysis and Critical Control Point (HACCP) system;
- Chapter 3 discusses the research methodology. It explains the study design, the data collection method and the data analysis that was undertaken to analyse data;
- Chapter 4 presents the results and reports on the study findings;
- Chapter 5 discusses the results of the study;
- Chapter 6 presents the conclusion drawn from the study as well as recommendations to the eThekwini Municipality Health Department for further studies.

CHAPTER 2:LITERATURE REVIEW

2.1. INTRODUCTION

According to the World Health Statistics Quarterly 1997, surveys indicate that food-borne diseases may be 300-350 times more frequent than the reported number of cases tends to indicate[8]. It is believed that hundreds of millions of people worldwide suffer from diseases caused by contaminated food.[4]

The global incidence of food-borne disease is difficult to estimate, but it has been reported that in 2005 alone 1.8 million people died from diarrhoeal diseases.[4] A greater proportion of these cases can be attributed to contamination of food and drinking water. Estimates suggest that contaminated food causes approximately 76 million illnesses, 325 000 hospitalisations and 5000 deaths.[7] However, the majority of the food-related illnesses, hospitalisations and deaths are from unidentified causes.[7] More than 200 known disease are transmitted through food. [7]

The Government of South Africa has adopted a Primary Health Care (PHC) approach through the *National Health Plan for South Africa* and the Reconstruction and Development Programme adopted in 1994, and subsequently the *White Paper on Health: towards a National Health System*, published in November 1997.[9] The White Paper provides for the establishment of a national health system in South Africa which, will in broad terms, consist of three levels of health service delivery with each level responsible for specific functions. These functions provide for, inter alia, the rendering of services aimed at ensuring the safety of foodstuffs offered to the consumer.[10]

The services rendered by health authorities in South Africa aimed at ensuring that the food consumers are exposed to, does not cause them any harm, is generally referred to as "food safety control" [10]. This can be defined as a mandatory regulatory activity of enforcement by the relevant health authority to provide consumer protection and to ensure that all foods during production, handling, storage, processing, and distribution are safe and fit for human consumption and conform to safety requirements as prescribed by law. [10]

2.2. THE SOUTH AFRICAN LEGISLATION RELATING TO FOOD SAFETY

The South African legislation relating to food safety and the authorities that are involved in the administration and enforcement of such legislation include the following:

2.2.1. The Health Act 63 of 1977

This Act states the responsibility of all local authorities to render, *inter alia*, environmental health services, including food control, and provides for various food hygiene related regulations.[11]

However this Act has been repealed by the Health Act 61 of 2003 but the Regulations under this Act are still effective.

2.2.2. National Health Act 61 of 2003

The definition of Municipal Health Services (MHS) in terms of the National Health Act includes Food Control. Health services are to be provided by municipalities, Section 32(1), states that "Every metropolitan and district municipality must ensure that the appropriate MHS are effectively and equitably provided in their respective areas". [12]

The function of MHS was assigned to the Metropolitan and District Municipalities by the Minister for Provincial and Local Government by virtue of his authorisation in terms of section 84(3) of the Municipal Structures Act, 1998, which was published in Government Gazette No. 24228 on the 3rd of January 2003. [13]

Since then, the National Health Act, Act 61 of 2003 came into operation on the 2nd of May 2005. Section 32 of the Act clearly states the mandate of the metropolitan and district municipality, to ensure that appropriate MHS are effectively and equitably provided in its area while it also endeavors to provide a definition of MHS.

It is important to note that sections 1, 17, 20, 27, 28, 32 to 40, 42 to 52 and 54 to 64 of the Health Act, Act 63 of 1977, has not been repealed by section 93(1) of this Act which means that the regulations promulgated under Act 63 of 1977, such as those relating to food premises, milk sheds, etcetera remain operative and can be applied by every metropolitan and district municipality in addition to their by-laws.

2.2.3. Foodstuffs, Cosmetics and Disinfectants Act, 1972

The Foodstuffs, Cosmetics and Disinfectants Act, No 54 of 1972 (FCD Act) addresses the manufacture, sale and importation of foodstuffs from a safety public health and quality point of view and is administered by the Directorate of Food Control in the Department of Health. General law enforcement is conducted by authorized local authorities in their areas of jurisdiction. All foodstuffs manufactured, processed, or sold in South Africa are governed by the FCD Act from a human health perspective. Foodstuff should not contain microorganisms at levels, which may cause harm to humans upon consumption. This is one of the regulations of Section 2(1) (b) (i) of the FCD Act.[16]

2.2.4. Food by-laws of the City of Durban, 2000

The Food by-laws of the City of Durban set the objective of providing a legal and administrative framework within which eThekwini Municipality can develop and manage its food control obligations. The Food by-laws provide the food inspectorate with a framework written with a clear conception of the local conditions.[15]

2.3. ROLES AND RESPONSIBILITIES REGARDING FOOD SAFETY

Various health authorities within the national health system at national, provincial and municipal levels, are the three most important role players responsible for ensuring that the food safety management aspect and thus food hygiene, is effectively addressed.[10]

Everyone has a role to play, as well as organizers of special events, service providers such as caterers / suppliers of food and the consumers, in ensuring that food eaten is safe and will not cause harm. The inspection of food facilities is a crucial public service designed to prevent food-borne illnesses among retail food consumers. [10]

The following is a detailed description of the role, functions and responsibilities of the components of the national health system at present regarding food control from a food safety point of view.

2.3.1. Role and responsibility of the National Department of Health

The Directorate of Food Control in the National Department of Health, included in the Chief Directorate of Food Control and Non-Medical Health Regulation, is directly responsible for all matters relating to food safety at a national level and addresses this through the following broad objectives:[10]

- To protect consumers and facilitate trade by compiling food legislation and regulations that are in line with international standards;
- To ensure safe foodstuffs and compliance with legal requirements by means of effective monitoring; and
- To promote the health of all our people by informing and educating consumers, industry and law enforcers.

Specific objectives of the Directorate currently relate to, *inter alia*, the following assets:

- Improving the safety of food;
- Acting as National Contact Point for Codex Alimentarius and participating in its activities;
- Rationalizing and updating South African legislation related to food standards and related matters;
- Arranging and coordinating sampling of specific foodstuffs by provincial and local authorities as part of a routine food monitoring programme;
- Developing and distributing appropriate health education material to the relevant customers of the Directorate;

- Coordinating the activities of the role players involved in the safety of aviation food;
- Evaluating biopesticides, agricultural and stock remedies, and other chemicals from a food safety point of view;
- Developing a national Food Safety Programme Auditing System relating to the control of domestic as well as imported foodstuffs;
- Addressing the application of Hazard Critical Control Point (HACCP) through policy formulation and information, education and communication actions.

The functions of the Directorate regarding the control of foodstuffs are determined by the provisions of the Foodstuffs, Cosmetics and Disinfectants Act 54 of 1972(FCD Act). Food control within the health sector at a provincial and district/local level is integrated with the environmental health services rendered by the authorities.[10]

2.3.2. Role and responsibility of Local Authorities

The district health system, which includes local authorities, is responsible for the following broad functions:

- Health promotion services;
- Inter-sectoral collaboration;
- Community participation.

Rendering, *inter alia*, environmental health services to communities relating to the following:

- Maintenance of its area in a hygienic condition;
- Investigating complaints;
- Enforcement of relevant legislation;
- Identification and control of health hazards.

The statutory mandate of local authorities relating to food control derives from the authorisation of individual local authorities by the Minister of Health to enforce the provisions of the FCD Act and the regulations published there under, within their area of jurisdiction.[10]

Many local authorities including eThekwini Municipality have promulgated their own local regulations or by-laws applicable to various aspects of food control and which are mainly an extension of the national regulations relating to food hygiene.

For the coordination of food control activities such as sampling programmes, dissemination of information, training programmes, etcetera among metropolitan and district authorities as well as other role players, Food Control Committees have been established in many of the provinces and meet on a regional basis.[10]

2.3.2.1 Specific role and responsibility of the eThekwini Municipality Health Department

The Divisional Manager for Food Safety in the Central Operational Entity of eThekwini Municipality is responsible for the overall supervision of Food Safety. The goal of the Food Safety Division is to ensure that statutory health and safety standards are applied, that a safe and wholesome supply of food is available from food outlets in the area, and reduce the incidence of food poisoning.[16] eThekwini Municipality Health Department (EMHD) is an authorized local authority by the Minister of Health to enforce the provision of the FCD Act and regulations published thereunder, within its area of jurisdiction. The activities of the EMHD relating to food control include the following:

- Law enforcement based on inspections of food premises and sampling of foodstuffs, (including milk and other perishable foodstuffs).
- Health education for food processors, handlers and consumers, including the informal sector.
- Advising existing and prospective entrepreneurs of requirements relating to food premises and the safe handling of food.
- The investigation of all incidences of food-borne diseases that come to their attention and the introduction of appropriate control measures.
- The investigation of all food safety related complaints received and remedial action in this regard.
- Assisting with health certification of compliance of products, conditions of premises etcetera regarding certain foodstuffs destined for export.[16]

2.4. HYGIENE IN FOOD PREPARATION

WHO data indicate that only a small number of factors related to food handling are responsible for a large proportion of food-borne disease episodes. Common factors include: cross-contamination; food being handled by people with poor hygiene practices; preparation of food several hours prior to consumption, combined with temperatures that favour the growth of pathogenic bacteria or the formation of toxins and insufficient cooking or reheating of food to reduce or eliminate pathogens.[17]

Rules of good hygienic practices in food preparation deal broadly with three different areas: physical factors relating to the premises and equipment used, operational factors relating to the hygienic handling of food, and personal factors relating to questions of personal hygiene and training. [17]

2.4.1 Physical factors

- Premises, equipment, utensils and kitchen practices

Ideally, food preparation premises should be purpose built, sited in an area that is free from objectionable odours, smoke and dust and allocated away from refuse areas. [18] One usually has a limited choice about the building to be used and its location but the Food by-laws of the City of Durban specifies that it should be of sound construction and well maintained.[15] It further specifies that the working environment should be well lit, well ventilated and promote food safety. [15]

The equipment and utensils used in the preparation of food can act as sources of contamination. For instance, knifes or chopping boards used with uncooked products such as raw meat or poultry can become contaminated with pathogens. If these utensils are repeatedly used without being adequately cleaned, particularly if they are then used with cooked or RTE product, the pathogens can be transferred, posing a very serious threat to food safety. This can also happen if food handlers who work with raw food fail to wash their hands before handling RTE food. This process whether mediated by hands or equipment, causes contamination.[17]

The working environment should also be clean and easy to clean. Microorganisms can grow on any scrap or particle of food remaining on food preparation surfaces or lodge in some crack or crevice and this can act as a source of contamination.[17]

While most microorganisms will be removed by thorough physical cleaning it is important to note that a surface can appear clean although it may not be microbiologically clean.[17] Various studies have shown that raw foods can act as a source of pathogens. Raw foods can also contaminate cooked or RTE foods if they are stored together improperly.[18] The Food by-laws specifies that the layout of the premises and equipment should allow food to be stored and handled without contact between raw and cooked products, either directly or via equipment.[15]

To facilitate good personal hygiene the Food by-laws specifies that the premises must have adequate toilet facilities separated from the food production area as well as adequate hand washing facilities provided in the food production area.[15]

2.4.2 Operational factors

- Hygienic handling of food

Microorganisms can be found growing at temperatures ranging from about -10ºC up to more than 100ºC. The most important consideration is that water should be present in its liquid state. Most food-borne pathogens are mesophiles with an optimum growth temperature around body temperature of 37ºC. Bacteria can grow to dangerous levels if they have the right conditions for growth which is between 7ºC and 65ºC, but only if they have sufficient time to do so. [17] Temperature is one of the prime factors that control the growth of bacteria in food. Many types of pathogens and spoilage bacteria can be prevented from multiplying and causing cause food-borne illness with proper temperature practices. [18]

A large part of the hygienic handling of foods relates to the correct use of temperature to control of microorganisms- avoiding temperatures where microbial growth is possible and, where appropriate, ensuring that temperatures are sufficiently high to kill microorganisms. Regulation 918 under the Health Act, 1977 (Act No. 63 of 1977) specifies that relevant temperatures for RTE food must be kept at more than 65ºC when served hot or must be kept at less than 7ºC when served cold. [11]

Dish cloths left wet can be an important reservoir of contaminating organisms that can be spread around foods and food contact surfaces as the cloth is used. [17] The food also needs to be protected from other sources of contamination such as insects, rodents and other animals. Surveys have shown that up to 15% of pet dogs excrete salmonellae.[19]

Rats and mice can contaminate food with organisms picked up from sewers, garbage and other sources via their fur, urine, faeces or saliva. Flies, cockroaches, ants and other insect pest can transfer organisms from sources contaminated with pathogens to foods. Flies are particularly important in this respect as they are associated with both food handling areas and contaminated areas such as toilets and refuse heaps. They also have the unfortunate habit of feeding by regurgitating their previous meals on to foods to help liquefy them. [20]

2.4.3 Human or personnel factors

- Food handlers

The food handlers can often be a major source of contamination.[15] Handling of food can introduce and spread pathogenic microorganisms. Food handlers may carry pathogens without experiencing any serious ill-effects themselves. *Staphylococcus aureus* is commonly associated with skin, nose, throat and infected skin lesions, particularly in primate such as humans where 20-50% of healthy individuals can carry organism. [19]

There are several good hygiene practices that a food handler should observe. Hands should be washed regularly with soap in clean water, especially before starting to handle food, after going to the toilet, and after handling raw food and food waste. In all these activities hands may become contaminated with pathogens that can be transferred to food. [19]

It is easier to keep hands clean if finger nails are kept short and jewellery such as rings are removed as dirt can become lodged under these and may be difficult to remove. Food handlers should avoid coughing into their hands or touching their hair, nose, mouth while handling food without washing their hands after. [18]

Many of the basic rules of food hygiene are already observed as part of traditional religious or cultural habits that go back thousands of years, but the reasons for their importance in terms of food safety are often not clearly understood. It is easy for lapses to occur resulting in a threat to food safety. [17]

2.5. MICROORGANISMS AND FOOD SAFETY

Microorganisms that are of importance to food safety can be viruses, protozoa and bacteria. This study focused on bacteria since these are the more prominent microorganisms in the context of food safety especially in developing countries.[4] The particular bacteria can be divided into two groups namely the pathogenic microorganisms and the bacterial indicator organisms.

2.5.1 Bacterial food-borne pathogens

Bacteria are a common cause of food-borne illness and exist everywhere in nature. They are in the soil, air, water and food we eat. Symptoms for bacteria infections are delayed because the bacteria need time to multiply. Bacteria are usually not seen until 12-72 hours or more after eating contaminated food. Amongst the most common bacterial food-borne pathogens are:

- Pathogenic *Escherichia coli*
- *Salmonella*
- *Staphylococcus aureus*

2.5.1.1 *Escherichia coli*

Escherichia coli (*E. coli)* is a pathogen that can survive refrigeration and freezer storage. If present, the bacterium can multiply very slowly at 5 degrees Celsius. [14] While it can be a severe pathogen, it can easily be destroyed through cooking. *E. coli* is the only valid organism for the monitoring of fresh vegetable foods and it is the organism (indicator) of choice for determining faecal contamination of milk. [17]

2.5.1.2 *Salmonella*

Salmonella is most commonly associated high protein foods such as meat, poultry, fish and eggs. However, any food that becomes contaminated and then held at improper temperatures can cause salmonellosis. Salmonelossis is a major problem in most countries.[10] *Salmonella* is destroyed at cooking temperatures above 65 degrees Celsius.[17] The major causes of salmonellosis are contamination of cooked foods and insufficient cooking. Contamination of cooked foods occurs from contact with surfaces or utensils that were not properly washed after use with raw products.[17] Food can also be contaminated by infected food handlers, pets or pest, or by cross contamination owing to poor hygiene. [19]

2.5.1.3 *Staphylococcus aureus*

Staphylococcus aureus (*S. aureus)* is carried by about 25-40% of healthy population.[19] Human's respiratory passages, skin and superficial wounds are common sources of *S. aureus.* When *S. aureus* is allowed to grow in food, it can produce a toxin that causes disease. [18] Growth temperature is between 7 and 48 degrees Celsius.[19] Although cooking destroys the bacteria, the toxin produced is heat stable and may not be destroyed.[18] Staphylococcal food poisoning occurs most often in foods that require hand preparation, such as potato salad, ham salad and sandwich spreads. Sometimes these types of foods are left at room temperature for long periods of time, allowing the bacteria to grow and produce toxin.[20] Good personal hygiene while handling foods will help keep *S. aureus* out of foods, and refrigeration of raw and cooked foods will prevent the growth of these bacteria if any presence. Inadequately cleaned equipment or raw animal products may be the sources of contamination. [18]

2.5.2 Bacterial indicator organisms

Indicator organisms have historically been used to indicate the presence of pathogens of intestinal origin as a result of direct or indirect faecal contamination. The main objective of using bacteria as indicators is to reveal conditions of treatment of the product which may imply a potential hazard that is not necessarily present in the specific sample examined but could be present in parallel samples.[21]

Routine examination of foods for a range of pathogenic microorganisms is impractical. In order to assess the microbiological safety from food-borne pathogens, widespread use groups or species which are easily enumerated and who's presence in foods indicate exposure to conditions that might introduce hazardous organisms and /or allow their growth are used. [21]

Most processed food should be regarded as unwholesome when they have large population of microorganisms, even if the organisms are not known to be pathogenic. [21]

For this study the following bacterial indicator tests were used to assess the bacterial quality of the sampled food:

2.5.2.1 Numbers of total bacteria

The high counts in RTE foods often indicate contaminated raw materials in perishable products and may indicate unsuitable time and/or temperature storage conditions. The use of total bacteria counts has a number of advantages. If it is high, or if it varies widely among samples from different lots or within a lot, microbiological control during preparation was probably inadequate. [21]

2.5.2.2 Enteric indicator bacteria

The presence of enteric bacteria, for example, coliforms and *Escherichia coli* (*E. coli)* have been widely accepted as indicators of faecal contamination and therefore the indicators of the possible presence of pathogens of enteric origin. A common practice is to use tests for coliforms, including *E. coli* for screening and if there is no reason to determine the likelihood of feacal contamination, the coliforms are subjected to further test to establish whether any of them are *E.coli.*[18] Coliforms have proved to be of value as safety indicators. In RTE food products their presence in considerable numbers indicates:

- Inadequate processing and /or post process recontamination due to cross contamination by raw products, dirty equipment or poor hygienic handling.
- Microbial proliferation, which could have allowed multiplication of wide range of pathogenic and toxigenic organisms. [21]

2.5.3 Microbiological standards

Regulation promulgated in terms of the FCD act makes provision for the microbiological standards or specification for certain foodstuffs. Table 1 indicates the standards as stipulate by the Regulation Governing Microbiological for foodstuffs and related matters (R692 of 16 May 1997). [21]

Table 1: *Microbiological standards for foodstuffs

Food category	Analysis	Permissible limits
Cooked meat	*Escherichia coli* (pathogens and indicators	0/20g
	Staphylococcus aureus	0/20g
	Salmonella	0/20g
	Total bacteria count	<10 000/g
	Coliform	0/20g
Cooked food :pastry, deep fried potatoes chips, ready-to-eat frozen meals, pizza	*Escherichia coli* (pathogens and indicators	0/g
	Staphylococcus aureus	<10/g
	Salmonella	0/25g
	Total bacteria count	<10 000/g
	Coliform	<10/g
Cold meal items: cold meat, salads, dried vegetables	*Escherichia coli* (pathogens and indicators	0/g
	Staphylococcus aureus	<100/g
	Salmonella	0/25g
	Total bacteria count	<200 000/g
	Coliform	<200/g

*Summarised from FCD Act, Regulation 692 of 16 May 1997

2.6 THE HAZARD ANALYSIS AND CRITICAL CONTROL POINT (HACCP) SYSTEM

Meeting the huge challenge of food safety in the 21st century will require the application of new methods to identify, monitor and assess food-borne hazards. Both traditional and new technologies for assuring food safety should be improved and fully exploited. This needs thorough legislative measures where suitable, but with much greater reliance on voluntary compliance and education of consumers and professional food handlers. [22]

Hygienic food handling aims to control the presence of pathogens in food by controlling each of the contributory factors. When outbreaks of food-borne disease occur it is because there has been a loss of control over one of the factors. [10]

Where general rules of food hygiene are followed, they establish a baseline of good practice in preparation that can be an important role in ensuring food safety. One approach to checking the safety of foods would be to test them to see if they contain specific pathogens or other organisms that might indicate the presence of pathogens. [18]

Microbiological testing can be very costly and only gives information after the event, when problem has already arisen. To overcome this problem the DOH Food Safety Directorate introduced new HACCP Regulations under the FCD Act as a better approach to control microbiological quality at source, during production, so that safety is built into the product. [14]

HACCP involves the systemic evaluation of a food processing or preparation procedure to identify hazards associated with ingredients or the processing procedure itself and to find out how

those hazards can be controlled. The system is so specific in that it decides which steps in the process are essential to controlling hazards so that attention can be focused on them. [20] Many countries have recognized HACCP in their food safety regulation and their enforcement procedures are being adapted to ensure that food industries apply HACCP in a systematic way. [23]

2.7 INTERNATIONAL AND NATIONAL STUDIES

Food safety, particularly in relation to its microbiological quality, has become a major issue not only in Europe and the USA but world wide.[22] The RTE food products provide a source of readily available and nutritious meals for the consumer. However questions have been raised about the safety and microbiological quality of these food products.

The global importance of food safety is not fully appreciated by many public health authorities despite the constant increase in the prevalence of food-borne illness. Numerous devastating outbreaks of salmonellosis, cholera, enterohaemorrhagic *Escherichia coli* infectious, hepatitis A and other diseases have occurs in both industrialized and developing countries. In addition, many of the re-emerging or newly recognized pathogens are food-borne or have a potential of being transmitted by food and/or drinking water. [24]

Surveys in the late 1980's and early 90's in Australia, in the USA and UK showed that consumers perceived that the presence of synthetic chemicals, pesticides and additives in food were at the top of their list of threats to food safety. Negative views about these perceived threats persisted in the late 90's although a national telephone survey of 702 Australians conducted by Quantum Market Research in 2000 indicated a shift toward food poisoning as the predominant concern. Seventy two percent (72%) of respondents in the survey reported concerns about food poisoning. Pesticide use still rated as the second highest concern (68% of respondents) followed by tampering with food in manufacturing process (65% concerned).[25]

Surveys conducted by the Australian Supermarket Marketing Institute indicated that shoppers in 1997 were more concerned about food hygiene compared with earlier surveys done in 1992 and 1994. This suggests that shoppers were more aware of microbial contaminants, although concerns about pesticides still remained high. [25]

In a 1998 survey of 566 Canberra adults, randomly selected from the electoral roll, only 29 respondents reported concern about bacterial contamination.[26] Yet of those consumers who expressed concerns about food safety (n=345), the main concerns were, handling and storage (28%); chemical contamination (chemicals, pesticides) (23%); and additives and preservatives (10%). Despite more than half the respondents expressing concern about food safety, the results suggest some ignorance of bacteria contamination as the major risk to food safety. In this survey,

respondents ranked take-away outlets and restaurants as the most likely source for food poisoning and the home as the least likely source. [25]

Chiou and Wang in the study conducted in 1996 examined the microbiological quality of 300 RTE heated food products sold in southern Taiwan. Their results indicated that the percentage of food products not meeting the microbiological standards accepted by the Republic of China regarding aerobic plate count, coliform and *E. coli* were 18%, 20% and 8 % , respectively. [27]

Consumer knowledge of food and food safety practices is declining especially in people with lower levels of education[28] and in younger people.[29] Personal hygiene practices such as hand washing when preparing food are declining. [18]

Poor personal hygiene causes more than 90% of the sanitation problems in food service industry. WHO statistics showed that improper hand washing alone accounted for more than 25% of all food-borne illnesses. [30]

Little in the way of food-borne surveillance is done in Africa; as a result, the data is extremely scarce. Mosupye and Von Holy investigated the microbiological quality of RTE Street-vended food products in Johannesburg, South Africa, in the study conducted in 1999 In that study, 51 samples were taken to determine the microbiological quality; *Bacillus cereus* was detected in 22%, *Clostridium perfringens* in 16%. *Salmonella* spp. in 2% and *E. coli* (non-0157:H+) in 2% of the 51 food samples. [31]

If food hygiene is intended to prevent food poisoning then it follows that hygiene is more than cleanliness, it involves all measures necessary to ensure the safety and wholesomeness of food during preparation/processing, manufacture, storage, transportation, distribution, handling, sale and supply.[32]

CHAPTER 3: METHODOLOGY

3.1 INTRODUCTION

The research methodology for the study is discussed in this chapter. It comprises study population, the sampling technique, the data collection procedure and the statistical methods used for evaluating the checklist responses.

3.2 DEFINITION OF TERMS

- Take-away – premises where food is prepared and sold to the public and sitting areas for onsite consumption of food are not provided;
- Ready-to-eat – status of food being ready for immediate consumption at the point of sale. It could be raw or cooked, hot or chilled, and can be consumed without further heat-treatment including re-heating;
- Food-borne disease – a general term used to describe any disease caused by eating contaminated food or drink. Traditionally referred to as "food poisoning"; [21]
- Bacterial analysis – Tests done on food samples to assess whether a product contains bacterial pathogens;
- Contaminate means the effect exerted by an external agent on food so that it:
    - does not meet a standard or requirement determined by any law;
    - does not meet acceptable food hygiene standards or consumer norms or standards;
    - is unfit for human consumption; and "contamination" has a corresponding meaning. [17]
- Indicator microorganisms – Species, which are easily identified and whose presence in food indicate exposure to conditions that might introduce hazardous organisms and or allow their growth are used, including plate counts, enteric bacteria. [21]

3.3 STUDY DESIGN

A cross sectional observational, descriptive study was conducted from August to September 2005, to assess the microbiological quality and safety of perishable food sold by take-away food outlets in the Central Operational Entity of eThekwini Municipality, Durban.

One hundred pre-structured checklist forms were used to determine the state hygiene of food premises and food safety practices of food handlers by recording all observations (Annexure 2).

One hundred food samples were collected to determine actual microbiological quality of these products.

3.4 STUDY POPULATION AND SAMPLING

3.4.1 Population

The study population consisted of all take-away food outlets within the Central Operational Entity of eThekwini Municipality at the time of the study, whether licensed or not. There are about 1500 premises registered as take-away food outlets within the data base of eThekwini Municipality business licensing department.

3.4.2 The sample

The list of all take-away food outlets was obtained from the computer database of the Business Licensing Department of the eThekwini Municipality. A systematic random sampling method was used to make up the required sample size; from 1500 premises registered every 15^{th} food outlet was selected.

3.4.3 Determination of Sample Size

Sample size was estimated using Epi Info version 6.0. Assuming a population size of 1500 take-away food outlets and a population prevalence of *Staphylococcus aureus* of 80%, a sample of 100 take-away food outlets would provide an estimate which is within 8% of the true population value.

Similarly a sample of 100 take-away food outlets would provide an estimate of *Salmonella* prevalence which is within 6% of the true population value, assuming that this value is 10%. Thus it was decided that a sample size of 100 take-away food outlets would be adequate for this observational descriptive study considering the resources available.

3.5 STUDY INSTRUMENTS AND DATA COLLECTION

3.5.1 Checklist Forms

Pre-structured checklist forms were used by Environmental Health Practitioners (EHP's) to record all the observed findings in the food preparation areas of the take-away food outlets (Annexure 2).

Each time food is handled prior to serving; there is an increased risk of contamination caused by personnel, equipment, procedures and other factors. [18] In this study the following factors and practices were observed and measured:

- General hygiene conditions of selected food shops;
- Working surfaces for preparation of food;
- Protective clothing worn by food handlers;
- Hygiene status of food handlers;

- Handling of cooked food;
- Provision of wash hand basins for foodstuff handlers in the food preparation areas;
- Hygiene status of toilets facilities used by food handlers;
- Location of refuse bin areas;
- Provision and accessibility of first aid room or box; and
- Pest control.

3.5.2 Food sample collection and transport procedure

One sample of the either stew or salad or any perishable foodstuff was taken per selected take-away food outlet. Food samples were collected twice a week for five consecutive weeks. On the day of sampling, the samples were taken throughout the day till 16:30 at the latest, after when EHP's brought the samples to the laboratory. Sampling of foodstuff was conducted according to the FCD Act. [14]

Approximately 250 grams of food was weighed on a scale and was taken with a washed and dried sampling spoon which was dipped into alcohol and flamed. The samples were spooned into individual sterile glass sampling bottles, labelled accordingly. Prior to sampling, the holding temperature of food was taken with a portable thermometre, also washed, dried ,dipped into alcohol and flamed prior to each sampling in order to sterilize it thus preventing cross contamination. The thermometrerwas inserted into the centre of food mass and held until a steady reading could be measured. A food sampling form was completed by EHP's collecting the food sample (Annexure 3).

The samples were immediately placed into an insulated cooler box containing ice packs and transported to the microbiology laboratory at eThekwini Municipality Health Department at approximately 2°C. At the Laboratory the samples were refrigerated at 2°C for maximum of 24 hours, whereafter these were analysed, according to methods described below.

3.5.3 Microbiological analyses

This analysis was done to determine the actual bacterial quality of food taken from take-away food outlets. Analysis was conducted by a qualified Laboratory Technologist. All glassware used in the testing was autoclaved under the supervision of the Laboratory Technologist in order to ensure that it was sterilized before use. Samples were plated, according to methods described below:

3.5.3.1 Total bacteria aerobic plate count test

Ten grams of sample was weighed and placed into 90 ml peptone water and placed in a Stomacher for 2 minutes. Subsequent 10-fold dilutions were made to 10^{-6}. All dilutions were

plated by the pour plate method, in duplicate, using Plate Count Agar, according to ISO method SANS 4833:1991.[33] The plates were incubated at 35°C for 48 hours and duplicate plates containing between 30 and 300 colonies were counted. Average counts obtained were expressed as colony forming units per gram of food (cfu/g).

3.5.3.2 Coliform count (CC) and *Escherichia coli (E. coli)* Test

Above dilutions were plated by the pour plate method, in duplicate, using Violet Red Bile Agar according to ISO method 4831: 1991.[34] Plates were incubated at 37°C for 24 hours. Duplicate plates containing between 15 and 150 typical coliform colonies were counted. Average counts obtained were expressed as colony forming units per gram of food (cfu/g).

Five presumptive *E. coli* colonies were picked off each plate and each colony inoculated into a tube of tryptone water and a Gram stain conducted. Incubation occurred at 37°C for 24 hours whereafter the formation of indole was tested by adding Kovac's reagent.[35] A positive indole test and the presence of short Gram-negative rods confirmed the presence of *E. coli*.

3.5.3.3 Salmonella Test

Twenty five grams of food sample was placed into 225 ml of Buffered Peptone Water and incubated at 37°C for 24 hours, according to ISO method 6579:1993 (E).[36] Ten ml and 0.1 ml of this suspension was then inoculated into 100 ml Selenite Cysteine Broth (SC) and 10 ml Rappaport-Vassiliadis Medium (RVS), respectively. SC flasks were incubated at 37°C for 24 hours and RVS tubes at 42°C for 24 hours. Thereafter, a loopful of suspension from each of the flasks and tubes was plated onto Xylose Lysine Deoxycholate Agar (XLD) and Brilliant Green Phenol Red Lactose Sucrose Agar (BPLS) according to the method described in the above-mentioned method. Typical *Salmonella* colonies were picked off and streaked onto Nutrient Agar for purity and incubated at 37°C for 24 hours. These cultures were then placed onto API 20E® (Analytical Profile Index) strips for identification. Results were recorded as the presence or absence of *Salmonella* in a test portion of 25 grams of food sample.

3.5.3.4 *Staphylococcus aureus* (*S. aureus*) Test

Dilutions from 3.5.3.1 were plated onto Baird Parker Agar containing appropriate supplements, in duplicate, by using the spread plate method, according to SABS method SANS 760.[37] In order to obtain a count at the 10^{-1} dilution, the method as described in the above, was followed. In brief, 1 ml of the suspension is plated over 3 plates. This is done in duplicate. The sum of the colonies counted over 3 plates is taken as the first count. The second count is obtained from the second set of 3 plates. The average of these 2 counts is recorded as the count for the 10^{-1} dilution. All plates

were incubated at 37°C for 48 hours. Typical *S. aureus* colonies were counted and average counts obtained were expressed as colony forming units per gram of food (cfu/g).

Five typical colonies were picked off and the coagulase test conducted on these using the Staphylase Kit DIR 595®. Coagulase positive colonies confirmed the presence of *S. aureus*.

3.6 MEASURES TO ENSURE QUALITY OF DATA

3.6.1 Validation

Validity was established by conducting a pilot study. The questionnaire was first tested through involvement of all Environmental Health Practitioners in the food section of Environmental Health Services of EMHD. Five food shops were first visited to test the questionnaire. Feedback from this pilot enabled a revision of some of the questions to improve its quality before the commencing the study.

3.6.2 Training of data collectors

Environmental Health Practitioners (EHP's) based in the food section of Environmental Health Services of EMHD were trained to collect the data. The aim of the training was to reduce the possibility of reporting bias. During the training the EHP's were issued with an instruction sheet detailing the nature of the research, the reason why the research was being done, and the objectives of the study. Each data collector was allocated identification number, ranging from 001 – 010, which was recorded on the front page of the each questionnaire for easy reference purposes.

3.6.3 Field Supervision

The researcher conducted the following field supervision:

- Checking of forms, ensuring that forms were filled in correctly and that there were no missing data;
- Checking that samples were labelled correctly;
- Ensuring that collection of data was done timeously.

The role of the researcher during data collection was very important in that it ensured supervision and accurate, reliable and quality data was received. This reduced the possibility of information bias.

3.6.4 Data processing

Before the analysis was done, the data set was checked to identify outlying values. Outliers can strongly influence and bias the results thus it was important to detect and correct the data before it was processed and analysed. During editing of the checklist forms and laboratory results, the data

was captured on a Microsoft Excel spreadsheet, thereafter the data set was cleaned of possible capturing errors. The data was then analysed with SPSS software package (SPSS Inc., Chicago, Illinois, USA). Double entry of data was done whereby two data typists punched in the data independently and the two sets of data compared for discrepancies. Where errors were picked up, the researcher checked the raw data. Checklists and questionnaires were filed so that it was easy to verify forms with queries.

3.6.5 Coding of variables

Some variables from the closed-ended questionnaire were coded to facilitate statistical analysis. Table 2 (a) and Table 2 (b) illustrate how variables were grouped.

Table 2 (a): Coding of variables in checklists for premises condition and food handling (Annexure 4)

Variable	Recorded as fair or good or excellent when:	Recorded as very poor or poor when:
Wall surface ,floor surface, equipment, sink, ceiling, working surfaces	Discretionary decision when situation is deemed satisfactory or acceptable	Discretionary decision when situation is deemed unsatisfactory or unacceptable
Other variables	**Recorded as "YES" when:**	**Recorded as " NO" when:**
Hygiene status of the food handlers	Discretionary decision when situation is deemed acceptable	Discretionary decision when situation is deemed unacceptable
Provision of wash hand basin, soap, nail brush and toilet paper	Provided	Not provided
Provision and accessibility of a First Aid room	Provided Accessible	Not provided Not accessible
Pest control measures	Carried out.	Not carried out

Table 2 (b): Coding of variables for bacterial analysis (Annexure 11)

Variable for analysis	Recorded as not detected when:	Recorded as non-compliance when:
Escherichia coli	Absent from sample size tested	Present from the sample size tested
Staphylococcus aureus	Absent from sample size tested	More than 10
Salmonella Test result	Absent from sample size tested	More than 10
Total bacteria count Test result	Absent from sample size tested	More than 10
Coliform count Test result	Absent from sample size tested	More than 10

3.7 DATA ANALYSIS

3.7.1 Descriptive component

Analyses of the data to see if the three primary objectives were met were done descriptively using frequency tables and bar charts. Categorical variables were presented as frequency counts and percentages, while quantitative variables were summarized using mean, median, standard deviation and range.

3.7.2 Analytical component

In all statistical testing, a p value <0.05 was considered as statistically significant.

In order to examine the relationship between bacterial counts and the hygiene status of the shops, a score was generated for hygiene based on the observations within the shops. Mean scores for walls, floors, equipment, sinks, ceilings and working surfaces by type of area were calculated. These means were averaged and this score was added to the scores from other questions. Such as the general hygiene conditions of the shop: working surfaces used for the preparation of foodstuffs, protective clothing worn by food handlers; hygienic status of food handlers; covering and storage of displayed food; provision of wash hand basin for food handlers; hygienic status of toilet facilities used by food handlers; location of the refuse bin area; provision and accessibility of first aid room or box; and, pest control measures. The score was expressed as a percentage out of a possible total of 31 points (Annexure 4).

Coliform counts and total bacteria counts results were found to be not normally distributed. This means that parametric statistical tests could not be applied to these data since their distribution did not conform to a Gaussian distribution. For this reason, the checklist score was correlated against the bacterial counts using Spearman's rank correlation, a non parametric correlation test. Scatter plots were used to graphically display the results of the relationships between checklist score and bacteria counts.

In order to examine the relationship between bacteria count and the food hygiene practices of food handlers, non-parametric Mann-Whitney tests were done to compare median colony counts between various practices, namely:

- Type of surface used for preparation of food;
- General hygiene status of food handlers;
- Food kept on display;
- Presence of soap, toilet paper and soap in the ablution facilities;
- Location of refuse bin areas;
- Provision and accessibility of first aid room or box and
- Pest control measures.

3.8 OVERCOMING BIAS

3.8.1 Selection bias

Selection bias was reduced by using systematic simple random sampling method to make up the required sample size. All take-away food outlets in the Central Operational Entity of Ethekwini Municipality at the time of the study were included in the study population.

3.8.2 Interviewer bias

In this study there are three types of errors that could have been caused by interviewers' behaviour, namely: errors in asking questions, errors in recording answers and errors due to

cheating. The interviewer bias was reduced by the fact that all interviewers were well trained and experienced in interviewing.

Every possible precaution was taken in the construction of the checklist (questionnaire) and the supervision of interviewers to minimize these errors (see 3.6.2). All EHP's involved in data collection were given an instruction document (Annexure 5)

3.9 ETHICAL CONSIDERATION

Ethical approval was obtained from the Biomedical Research Ethics Committee of the University of KwaZulu-Natal, Nelson Mandela School of Medicine (Annexure 6).

Permission to conduct this study was granted by the eThekwini Municipality Health Department and the study was conducted as prescribed by the approval letter (Annexure 7).

All business owners of the selected food shops were informed about the study. In a case of a visit carried out in the owner's absence, the person in charge during the time of the study was informed. An information document informing the participants about the study was handed to the participant (Annexure 8). All participants signed a written consent to participate in the study (Annexure 9).

Confidentiality was ensured by the fact that checklist and questionnaires did not bear the participants name, surname, or identity number, as the checklist and questionnaires were given a reference number for identification purposes. Data entered into the computer system was coded so as to ensure confidentiality of participants.

The contents of the test and remaining foodstuffs not utilized in the analysis was suitably secured, sealed and disposed of by the Laboratory personnel (Laboratory Assistant) in an appropriate refuse facility which is in a secured area, free of public access within the premises of EMHD, where it was collected by the truck from Durban Solid Waste Department (DSW), after which it was then transported to the Municipal land fill site at Bisasar Road, Springfield. The disposal was done under security and supervision of DSW.

3.10 LIMITATIONS

The findings in this study were subject to at least these four limitations:

The information was gathered in the sample survey where a combination of judgement and convenience (non-probability) sampling for selection of the food handlers was used. A judgement sampling method was used in the absence of a sample frame of the food handlers. Although the results of the survey are set out in terms of numbers and percentages in tables, the reader should bear in mind that the information is more of a qualitative than of a quantitative nature.

The analysis was based on reported data on what was observed by an EHP during the time of inspection, the findings might be subject to reporting bias.

This analysis did not address possible confounders such as, the time at which the food was prepared versus the time at which it was served and also socioeconomic status (for example, education) of the food handlers and their food handling or /and preparation behaviours.

The system of data capturing of the EMHD was either not functional or was very difficult to access, as result of the information on the records of take-away food outlets could only be accessed from the database of the Business Licensing Department of eThekwini Municipality. The EMHD relied on another source for data which it had no control over, thus reliability of data was questionable.

3.11 SUMMARY,

A cross sectional observational, descriptive study was conducted in one hundred take-away food outlets. Checklist forms were used as a method of data collection. Food samples were collected in all food shops that were selected and visited during the time of the study. A method of observation was applied during the time of the visit. Microbiological analysis was performed on each food sample collected. Analysis of the three primary objectives was done descriptively using frequency tables and bar charts. To examine the relationship between bacterial count and the hygiene status of the shops, a score was generated for hygiene based on the observations within the shops. The score was expressed as a percentage out of a possible total of 31 points. Scatter plots were used to graphically display the results of the relationships between checklist score and bacterial counts. In order to examine the relationship between bacterial count and the food hygiene practices of food handlers, non-parametric Mann-Whitney tests were done to compare median colony counts between various practices of food handlers.

CHAPTER 4: RESULTS

4.1 INTRODUCTION

The study was designed to determine the quality and safety of perishable food sold by take-away food outlets in the Central Operational Entity of eThekwini Municipality. The results are organized according to the objectives, namely

4.1.1 Primary objectives

- The state of hygiene of food premises.
- Food safety practices of food handlers.
- The bacterial quality of food taken from take-away food outlets.

4.1.2 Secondary objectives

- To assess the relationship between the state of hygiene of the food premises and the bacterial quality of the food,
- To assess the association between the food safety practices of food handlers and the bacterial quality of the food.

4.2 THE STATE OF HYGIENE OF FOOD PREMISES

General hygiene conditions of selected food shops were observed to determine the conditions under which these foods were being prepared and to determine the potential sources of contamination. Areas that were selected within the food shop included the serving, preparation and storage areas. Each area that was observed was given a score between 1 if the conditions were very poor (unacceptable/unsatisfactory conditions) and 5 if the conditions were excellent (acceptable/ satisfactory conditions). Other areas that were observed included the provision of wash hand basins for food handlers, presence of soap; nail brush and toilet paper in the ablution facilities, location of the refuse bin area in relation to its access to the kitchen, the provision and accessibility of the first aid room/box and pest control measures. The following results indicate the overall findings of the survey.

4.2.1 Hygienic condition of food shops

Only 1(1%) of the food shops assessed by the EHP's had a very poor hygienic conditions in the serving areas. About three percent (2.8 %) were in a poor condition, however it was noted that of the 2.8%, 2.7% was because of the equipment that were kept in poor condition. Of the rest 26% were kept under fair, 50.4% good and 18% were in excellent condition (Table 3). Only 35% food

shops had wash hand basins located in their serving areas. Work surfaces in general were kept under satisfactory conditions.

Table 3: The level of hygiene of serving areas of the selected ready-to eat food shops in Central Operational Entity of eThekwini Municipality, Durban, 2005

Serving Area	Very poor		Poor		Fair		Good		Excellent	
	n	%	N	%	n	%	N	%	n	%
Wall surface	1	1.0	0	0.0	24	24.0	57	57.0	18	18.0
Floor surface	1	1.0	0	0.0	22	22.0	59	59.0	18	18.0
Equipment	1	1.0	14	14.0	52	52.0	17	17.0	16	16.0
Sinks / Wash Hand Basin	1	1.0	0	0.0	5	5.0	20	20.5	9	9.0
Ceiling	1	1.0	1	1.0	20	20.0	61	61.0	17	17.0
Working surface	0	0.0	0	0.0	14	14.0	51	51.0	16	16.0
TOTAL	**5**	**0.9**	**15**	**2.8**	**137**	**26.0**	**265**	**50.4**	**94**	**17.9**

Most (97 %) of the food preparation areas were either found in fair, good or excellent condition (Table 4). Only one (0.3%) had equipment kept under very poor hygienic conditions. Only one (0.5%) did not have wash hand basins located in their food preparation areas. Out of the 1.0% of the serving areas, 0.2% was either in poor or very poor condition and 0.3% of the working surfaces in this area were found to be in a poor condition.

Table 4: The level of hygiene of preparation areas of the selected ready-to-eat food shops in Central Operational Entity of eThekwini Municipality, Durban, 2005

Food Preparation Area	Very poor		Poor		Fair		Good		Excellent	
	n	%	n	%	n	%	n	%	n	%
Equipment	2	2.0	0	0	19	19.0	55	55.0	24	24.0
Sinks / Wash Hand Basin	1	1.0	1	1.0	23	23.0	51	51.0	21	21.0
Ceiling	1	1.0	4	4.0	23	23.0	56	56.0	16	16.0
Working Surface	0	0.0	2	2.0	19	19.0	54	54.0	25	25.0

Out of 100 food shops only 7 did not have storage areas (Table 5).

Table 5: The level of hygiene of storage areas of the selected ready-to-eat food shops in the Central Operational Entity of the eThekwini Municipality, Durban, 2005

Storage Area	Very poor		Poor		Fair		Good		Excellent	
	n	%	n	%	n	%	N	%	n	%
Wall surface	1	1.0	1	1.0	34	34.0	49	49.0	8	8.0
Floor surface	1	1.0	1	1.0	32	32.0	46	46.0	13	13.0
Equipment	1	1.0	17	17.0	36	35.0	9	9.0	31	31.0
Sinks/ Wash Hand Basin	1	1.0	1	1.0	2	2.0	16	16.0	4	4.0
Ceiling	1	1.0	2	2.0	27	27.0	51	51.0	12	12.0
Working surface	0	0.0	0	0.0	6	6.0	15	15.0	7	7.0

However it was observed that 1.2% and 5.2% of the equipment found in the storage areas were in poor and very poor conditions respectively. It was noted that out of the 5.2 % that was found to be in a poor condition, 4.0% was as a result of equipments which were not maintained clean. Only

5.7% and 6.6% had sinks /wash hand basins and working surfaces respectively located in the storage areas.

Table 6 shows that 5.8% of the toilet facilities were found to be in a poor condition and of this 5.8 %; 4.0 % was as a result of equipment which was not maintained clean and in some cases was dysfunctional and 0.2% was found to be under very poor condition. Sinks and ceiling of the 0.8% and 0.6% of the toilet facilities respectively were found to be in poor condition.

Table 6: The sanitary condition of toilet facilities of the selected ready-to-eat food shops in Central Operational Entity of eThekwini Municipality, Durban, 2005

Toilet Facilities	Very poor		Poor		Fair		Good		Excellent	
	n	%	n	%	n	%	N	%	n	%
Wall surface	1	1.0	1	1.0	30	30.0	59	59.0	9	9.0
Floor surface	1	1.0	1	1.0	35	35.0	52	52.0	11	11.0
Equipment	1	1.0	20	20.0	27	27.0	15	15.0	39	37.0
Sinks / Wash Hand Basin	1	1.0	4	4.0	19	19.0	58	58.0	18	18.0
Ceiling	1	1.0	3	3.5	26	26.0	59	59.0	11	11.0

4.2.2 Hygiene facilities in toilets

According to Table 7, 15% of the toilet facilities were not provided with soap for hand washing after using the toilet and 5% did not have toilet papers.

Table 7: Hygiene facilities in toilets of the selected ready-to-eat food shops in Central Operational Entity of eThekwini Municipality, Durban, 2005

	n	%
Are toilet facilities provided with soap		
Yes	85	85
No	15	15
TOTAL	**100**	**100**
Are toilet facilities provided with nail brush		
Yes	22	22
No	78	78
TOTAL	**100**	**100**
Are toilet facilities provided with toilet paper		
Yes	95	95
No	5	5
TOTAL	**100**	**100**

4.2.3 Location of the refuse bin area

Table 8 shows that 85% of refuse bin areas were located away from the kitchen.

Table 8: Location of the refuse bin area of the selected ready-to-eat food shops in Central Operational Entity of eThekwini Municipality, Durban, 2005

	n	%
Direct access to the kitchen	15	15
Aware from the kitchen	85	85
TOTAL	**100**	**100**

4.2.4 Provision and accessibility of a first aid room or box

Only 72% of the food shops were provided with either First Aid room or box and it was observed that they were all accessible as shown in Table 9.

Table 9: Provision and accessibility of a first aid room / box of the selected ready-to-eat food shops in Central Operational Entity of eThekwini Municipality, Durban, 2005

	n	%
Is the First Aid Room / Box provided		
Yes	72	72
No	28	28
TOTAL	**100**	**100**
Is it accessible to food handlers		
Yes	72	72
No	28	28
TOTAL	**100**	**100**

4.2.5 Pest control

Pest control service was rendered to 91% of the food shops either every six months or as often as it was required or necessary as indicated by Table 10 and records were kept as a proof.

Table 10: Pest control service of the selected ready-to-eat food shops in Central Operational Entity of eThekwini Municipality, Durban, 2005

	n	%
Pest control		
Yes	91	91
No	9	9
TOTAL	**100**	**100**
How often		
≥ to 6 monthly	75	75
≤ to 6 monthly	16	16
No service provided	9	9
TOTAL	**100**	**100**

4.3 FOOD SAFETY PRACTICES OF FOOD HANDLERS

In all the food premises that were visited by the EHPs, food handlers' habits and their general cleanliness status were observed.

4.3.1 Type of protective clothing worn by food handlers

Most (74%) of food handlers were found wearing full aprons as protective clothing (Figure 1) and only 18 % had overall. More than half (53%) had their hair covered. 14 % were observed using gloves during the preparation of food.

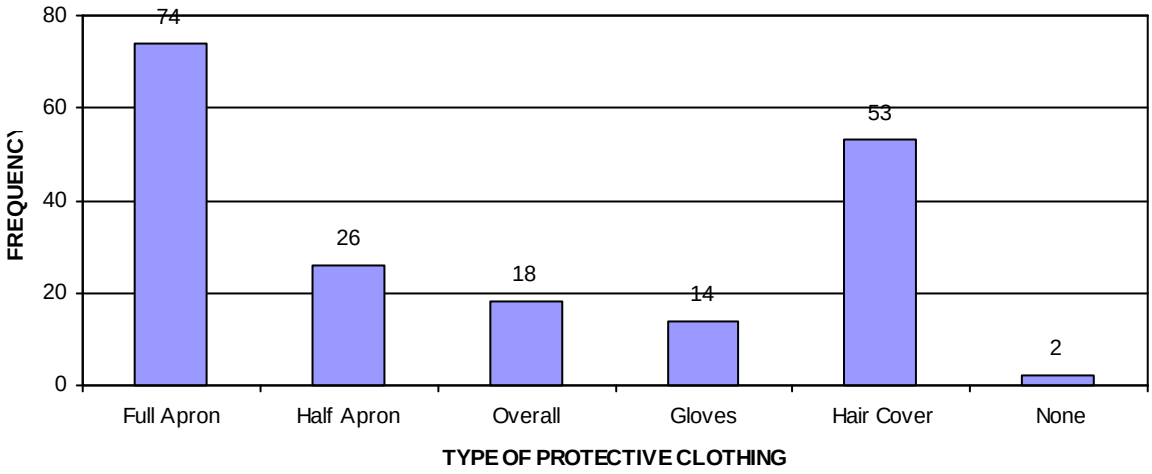

Figure 1: Type of protective clothing used by food handlers of the selected ready-to-eat food shops in Central Operational Entity of eThekwini Municipality, Durban, 2005

4.3.2 The hygienic status of the food handlers

The hygienic status of food handlers in this report appears satisfactory (Table11) in that 97% of them had short nails, 99% had their hands free of sores and nobody was found coughing or smoking while working with food. Only 15% were found wearing jewelery on their arms.

Table 11: Hygiene status of food handlers of the selected ready-to-eat food shops in Central Operational Entity of eThekwini Municipality, Durban, 2005

	n	%
Short/clean nails	97	97
Hands free of sores	99	99
Smoking while working with food	3	3
Coughing over food	0	0
Jewelry/bangles on the arms	15	15

4.3.3 Handling of cooked foodstuff

Table 12 shows the handling of cooked foodstuff, 91% of food on display was covered and only 5% was exposed to contamination, 4% of cooked food was stored together with the uncooked food.

Table 12: Handling of cooked foodstuff of the selected ready-to-eat food shops in Central Operational Entity of eThekwini Municipality, Durban, 2005

	n	%
Is the cooked food on display covered		
Yes	91	91
No	5	5
Not applicable	4	4
TOTAL	**100**	**100**
Is it separately stored from uncooked food		
Yes	96	96
No	4	4
TOTAL	**100**	**100**

4.3.4 Type of work surfaces used for the preparation of foodstuffs

Table 13 shows the type of surface that food handlers used when preparing food. The majority (99%) of the food shops were using metal surfaces for food preparation, 20% used plastic, 4% used wood and only 1% used glass.

Table 13: Work-surfaces used by food handlers for preparing the ready-to-eat food in Central Operational Entity of eThekwini Municipality, Durban, 2005

Surface	n*
Metal	99
Wood	4
Plastic	20
Glass	1
Cloth	7

*More than 100 due to food outlets using more than one type of work surface

4.3.5 Provision of a wash hand basin for food handlers

Table 14 shows that 3% of the food shops did not have wash hand basins provided for food handlers, 10% of those provided with one, did not have soap and 52% had no nail brushes.

Table 14: Wash hand basins for food handlers of the ready-to-eat food shops in Central Operational Entity of eThekwini Municipality, Durban, 2005

	n	%
Is the wash hand basin provided		
Yes	97	97
No	3	3
TOTAL	**100**	**100**
Is it provided with soap		
Yes	88	88
No	9	9
TOTAL	**97**	**97**
Is it provided with a nail brush		
Yes	46	46
No	51	51
TOTAL	**97**	**97**

4.4 BACTERIAL QUALITY OF FOOD TAKEN FROM TAKE-AWAY FOOD OUTLETS

The results were obtained using the methods described in Chapter 3. Most (74%) of the food samples were collected between ten o'clock in the morning and one o'clock in the afternoon which includes lunchtime hour for most of the people and would give a true reflection of the quality of food to which consumers were exposed (Table 15).

Table 15: Time of interview and data collection of the ready-to-eat food samples in Central Operational Entity of eThekwini Municipality, Durban, 2005

Time of inspection	No.	%
10H00 <	2	2
10H00 – 13H00	74	74
13H00 – 16:30	24	24
TOTAL	**100**	**100**

Microbiological testing was conducted to determine the microbiological quality of these products. The holding temperatures were recorded per sample (Annexure 10), the lowest recorded temperature being 0°C and the highest being 95°C. Results of laboratory analysis (Annexure 11) shows counts in colony forming units per gram (cfu/g) and presence and absence of microorganisms tested for in perishable food products from selected shops sampled (Table 16).

4.4.1 Total aerobic plate count Test

About eighty percent (76%) of the food samples tested showed high total bacteria count.

4.4.2 Coliform count test

Coliforms were detected in 50% of the food samples tested.

4.4.3 *Escherichia coli* test, *Staphylococcus aureus* test, Salmonella test

Table 16 shows that of the hundred food samples taken for microbiological analysis none showed presence of *E. coli Type 1, S. Aureus*/g or Salmonella/g.

Table 16(a): Microbiological analysis of ready-to-eat foodstuffs in Central Operational Entity of eThekwini Municipality, Durban, 2005

Type of Bacteria	n	%
Escherichia Coli		
Yes	0	0
No	100	100
TOTAL		
Staphylococcus Aureus		
Yes	0	0
No	100	100
TOTAL		
Salmonella		
Yes	0	0
No	100	100
TOTAL	**100**	**100**
Total bacteria count		
Yes	76	76
No	24	24
TOTAL	**100**	**100**
Coliform count		
Yes	50	50
No	50	50
TOTAL	**100**	**100**

Table 16(b): Total bacteria counts and coliform counts

N	Valid	76	50
	Missing	24	50
Median		30,000	20,000
Minimum		100	100
Maximum		1,000,000	630,000
Percentiles	25	1,075	2,950
	50	30,000	20,000
	75	60,000	32,500

4.5 SUMMARY STATISTICS

As stated in the methodology section, (section 3.9 .1) the observation checklist form was allocated an overall numerical score, expressed as a percentage score. The highest score in a facility could be allocated was 31 (100% the lowest score was zero (0%). The mean percentage score was 83% and the median was 86%. The range was 27% to 97%; the standard deviation was 10 % (Table 17).

Table 17: Summary of observational checklist percentage scores by Environmental Health Practitioners of ready-to-eat food shops in Central Operational Entity of eThekwini Municipality, Durban, 2005 statistics

Percentage Score		
N	Valid	100
Mean		84
Median		86
Std. Deviation		10
Minimum		27
Maximum		97

4.6 RELATIONSHIPS

A nonparametric Spearman's correlation was used as a measure of linear association between Total Bacteria Count , and Percentage Observational Score Total and between Total Coliform Count and Percentage Observational Score (Table 18).

Table 18: Correlations between total bacteria count and percentage observational score total as well as correlations between total coliform counts and percentage observational score

Spearman's rho		Score	Total bacteria	Coliform
SCORE	Correlation Coefficient	1.000	0.09	0.004
	Sig. (2-tailed)	0.00	0.37	0.97
	N	100	100	100
Total bacteria	Correlation Coefficient	0.091	1.0	0.644(**)
	Sig. (2-tailed)	0.370	00	00
	N	100	100	100
Coliform	Correlation Coefficient	0.004	0.644(**)	1.000
	Sig. (2-tailed)	0.969	0.00	0.00
	N	100	100	100

** Correlation is significant at the 0.01 level (2-tailed).

The correlation was a significant ($p < 0.01$) positive correlation at the 0.01 level (2-tailed) between the total bacteria count ($r = 0.64$) in the food (Figure 2) $p = 0.969$. There was no correlation between the observational score and the total coliform count or between score and the total bacteria counts (Table 18 and Figure 2 and 3) $p = 0.370$.

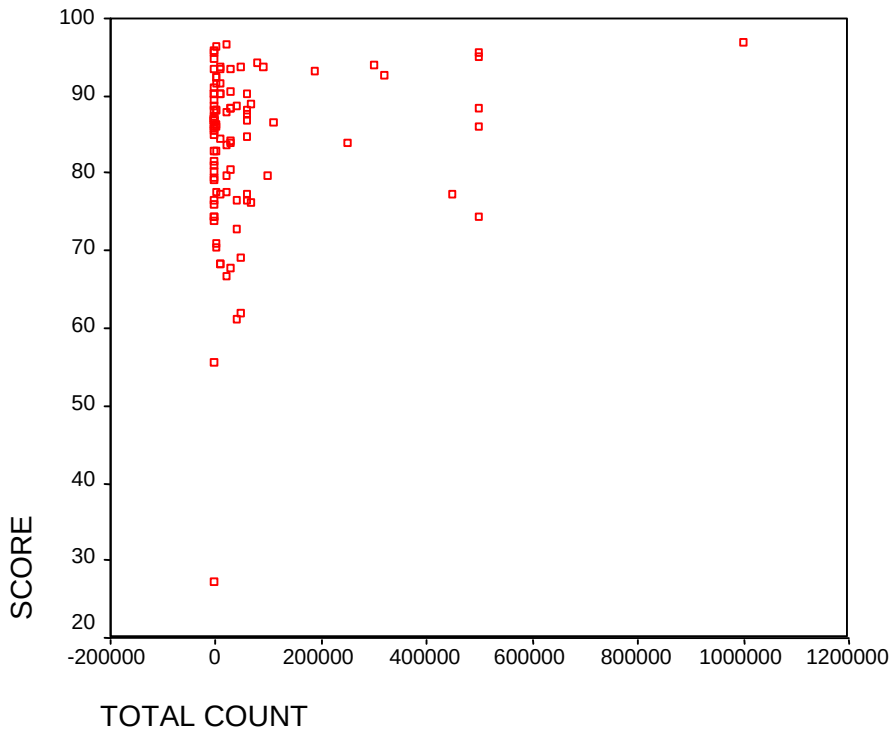

Figure 2: Numbers of total bacteria enumerated from the total bacterial count method

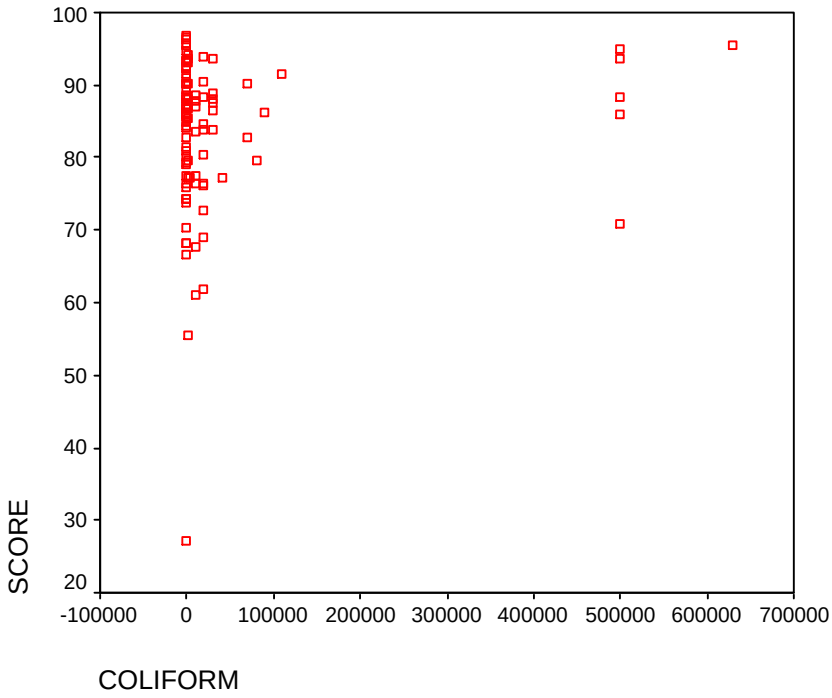

Figure 3: Number all scores of coliform enumerated from the coliform count method

4.7 ASSOCIATIONS BETWEEN BACTERIA AND GROWTH FACTORS

A nonparametric Spearman's correlations was used as a measure of linear association between total bacteria count, and temperature and coliform count and temperature (Table 19). A correlation was very significant ($p < 0.001$ level) although weak negative correlation between temperature and coliform ($r = -0.404$) in the food (Figure 4). There was a similar negative correlation between temperature and total bacteria count ($r = -0.451$) in the food (Figure 5). Coliform count was high in temperatures between 7°C and 65°C (Figure 5),but the high percentage of total bacteria count was also shown in temperatures less than 7°C (Figure 6).This suggested that high temperatures inhibits the presence of coliform.

Table 19: Correlations between numbers of total bacteria, coliforms and temperature

Spearman's rho		Total bacteria	Coliform	Temperature
Total bacteria	Correlation Coefficient	1.000	0.644(**)	-0.451(**)
	Sig. (2-tailed)	0.000	0.000	0.000
	N	100	100	90
Coliform	Correlation Coefficient	0.644(**)	1.000	-0.404(**)
	Sig. (2-tailed)	0.000	0.000	0.000
	N	100	100	90
Temperature	Correlation Coefficient	-0.451(**)	-0.404(**)	1.0
	Sig. (2-tailed)	0.000	0.000	0.000
	N	90	90	90

** Correlation is significant at the 0.01 level (2-tailed).

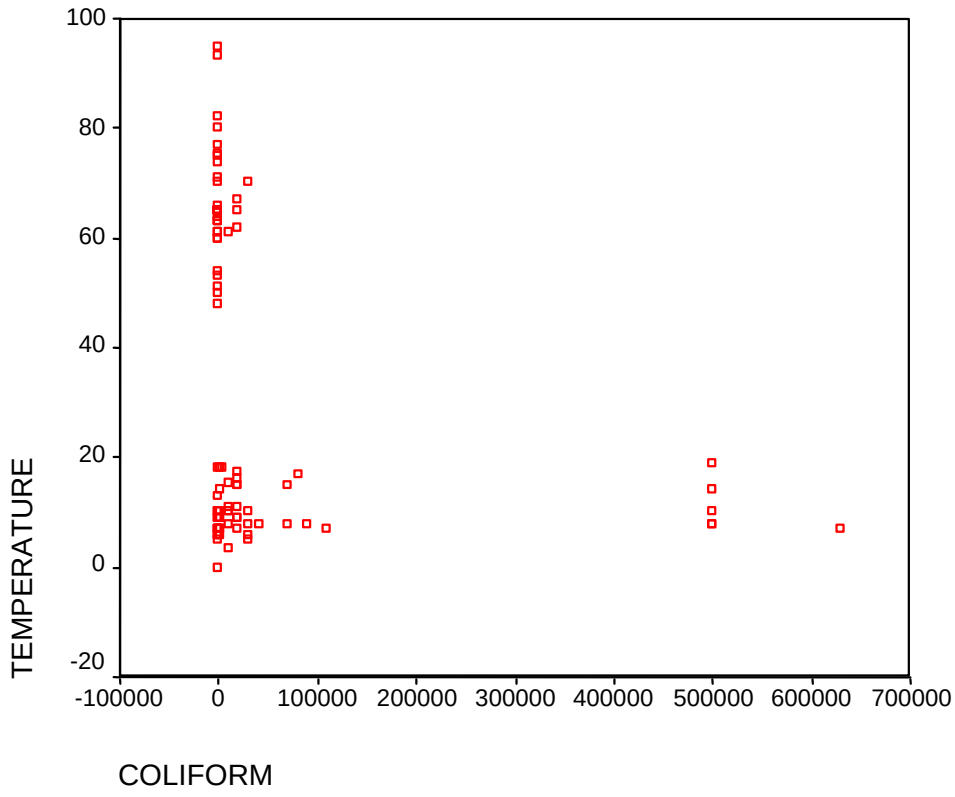

Figure 4: Correlation between temperature and coliform

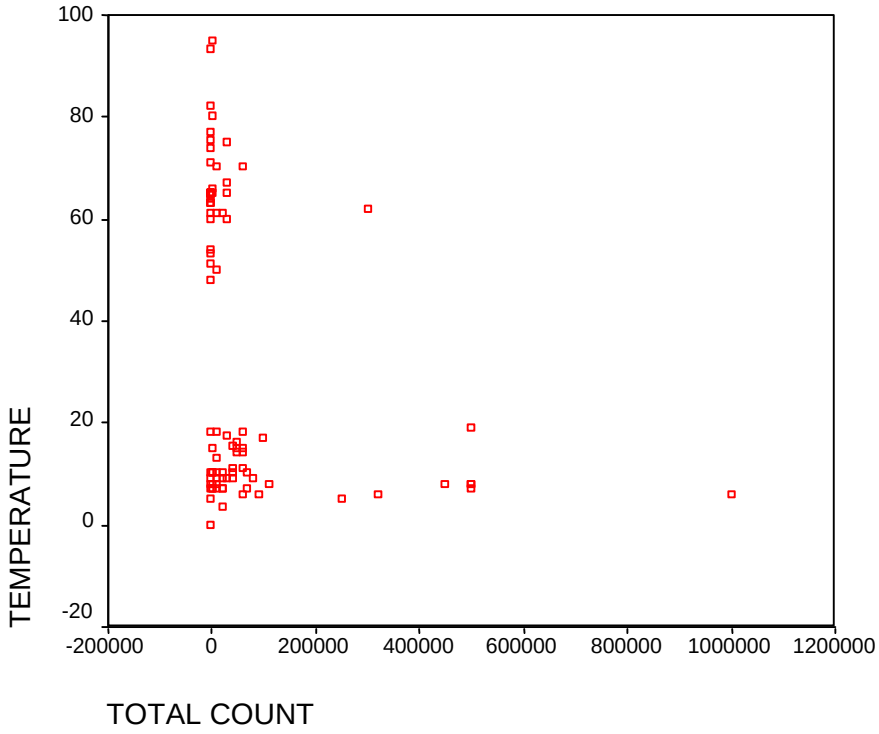

Figure 5: Correlation between temperature and total bacterial count

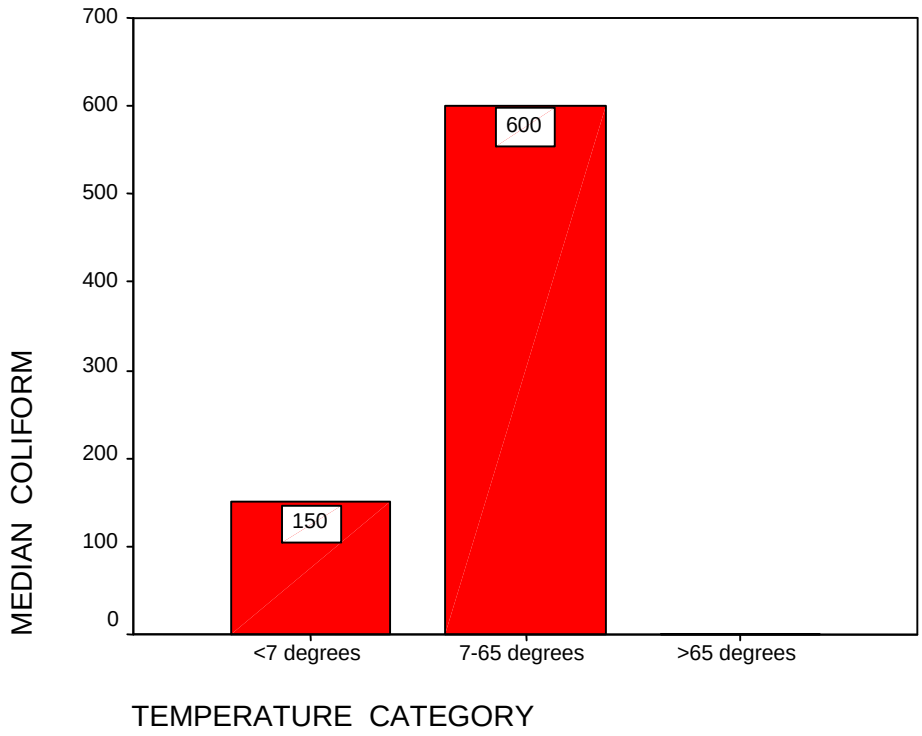

Figure 6: Median total coliform count by the temperature of food

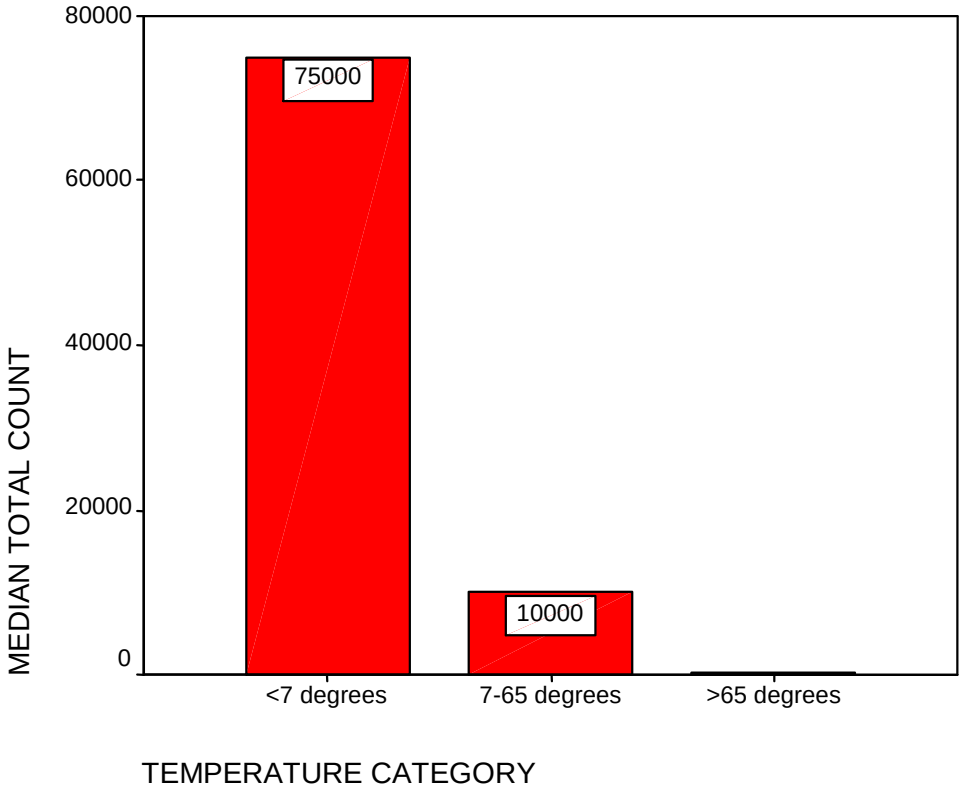

Figure 7: Median total bacteria count by the temperature of food

4.8 ASSOCIATION BETWEEN HYGIENE AND BACTERIAL CONTENT OF THE FOOD

A nonparametric Spearman's correlations was used as a measure of linear association between total bacteria count, and the observational cleanliness of food preparation areas and between total coliform count and the observational cleanliness food preparation area (Table 20).

Table 20: Correlations between total bacteria count, coliform count, food preparation areas and ablution facilities

Spearman's Rho
Food preparation areas

Variable 1	Variable 2	r-values	p-values
Total bacteria count	Walls	-0.070	0.489
Total bacteria count	Floors	-0.050	0.621
Total bacteria count	Equipments	0.011	0.914
Total bacteria count	Sinks	0.002	0.989
Total bacteria count	Ceilings	0.101	0.318
Coliform count	Walls	0.120	0.235
Coliform count	Floors	0.062	0.541
Coliform count	Equipments	0.115	0.261
Coliform count	Sinks	0.119	0.250
Coliform count	Ceilings	0.269(**)	0.007

** Correlation is significant at the 0.01 level (2-tailed)

In the food preparation areas, the correlation was not significant between total bacteria count and walls, floors, equipment, sinks, and ceilings (r = -0.070, -0.050, 0.0101, 0.002, and 0.101) respectively and between the coliform count and walls, floors, equipment, and sinks (r = 0,120, 0.062, 0115 and 0.119) respectively. The coliform and ceiling correlated significantly (r = 0.269).

In general the correlations were high and significant between the walls, floors, equipment, sinks and ceilings of food preparation areas. However there was no correlation between the total bacteria count or coliform count and the hygiene status of the food preparation areas.

4.9 ASSOCIATION BETWEEN FOOD SAFETY PRACTICES AND THE BACTERIAL CONTENT OF THE FOOD

The variance was measured using Spearman's between the total bacteria count, coliform counts and scores of:

- Working surfaces used for the preparation of foodstuffs,
- Protective clothing worn by food handlers;
- Hygiene status of food handlers;
- Covering and storage of displayed food;
- Provision of wash hand basin for food handlers;
- Hygiene status of toilet facilities used by food handlers;
- Location of the refuse bin area;
- Provision and accessibility of first aid room or box; and
- Pest control measures.

4.9.1 Association between total bacteria count, coliform count and the type of working surface

At significant level of 0.05 the type of surface used for food preparation seemed to have no association with total bacteria count and coliform count, as indicated in Tables 21.

Table 21: Type of working surface versus numbers of total bacteria and coliforms

Area	Variable 1	Variable 2	Number	p-value
Working surface	Total bacteria	Metal	99	0.700
	Coliforms	Metal	99	0.660
	Total bacteria	Wood	4	0.317
	Coliforms	Wood	4	0.325
	Total bacteria	Plastic	20	0.137
	Coliforms	Plastic	20	0.315
	Total bacteria	Glass	1	0.540
	Coliforms	Glass	1	0.660
	Total bacteria	Cloth	7	0.218
	Coliforms	Cloth	7	0.965

4.9.2 Association between total bacteria count, coliform count and the type of protective clothing

At significant level of 0.05 the use of any type of protective clothing for example full apron, half apron and overall seemed to have no association with total bacteria count and coliform count as indicated by Table 22.

Table 22: Type of protective clothing versus numbers of total bacteria and coliforms

Area	Variable 1	Variable 2	Number	p-value
Type of Protective Clothing	Total bacteria	Full apron	74	0.445
	Coliforms	Full apron	74	0.617
	Total bacteria	Half apron	26	0.134
	Coliforms	Half apron	26	0.447
	Total bacteria	Overall	18	0.413
	Coliforms	Overall	18	0.245
	Total bacteria	Gloves	14	0.444
	Coliforms	Gloves	14	0.510
	Total bacteria	Hair cover	53	0.300
	Coliforms	Hair cover	53	0.346

4.9.3 Association between total bacteria count, coliform count and the personal hygiene practices

At significant level of 0.05 personal hygiene practices for example, the wearing of gloves, covering of hair, short nails, hands free of sores and wearing of jewelery when preparing food seemed to have no association with total bacteria count and coliform count as indicated in Table 23.

Table 23: Personal hygiene practices versus numbers of total bacteria and coliforms

Area	Variable 1	Variable 2	Number	p-value
Personal Hygiene Practices	Total bacteria	Short nails	97	0.834
	Coliforms	Short nails	97	1.000
	Total bacteria	Hands free of sores	99	0.240
	Coliforms	Hands free of sores	99	0.940
	Total bacteria	Wearing jewelry	15	0.403
	Coliforms	Wearing jewelry	15	0.988

4.9.4 Association between total bacteria count, coliform count and the state of storage of food on display

At a significance level of 5% the state at which the food is stored on display had no association with total bacteria count and coliform count as indicated by Table 24.

Table 24: Storage of food on display versus numbers of total bacteria and coliforms

Area	Variable 1	Variable 2	Number	p-value
Storage of Food on Display	Total bacteria	Covered food	97	0.834
	Coliforms	Covered food	97	1.000

4.9.5 Association between total bacteria count, coliform count and the provision of wash hand basin for food handlers

At a significance level of 5% the provision of wash hand basin in the food preparation areas for use by food handlers had no association with total bacteria count and coliform count as indicated by Table 25.

Table 25: Wash hand basin versus numbers of total bacteria and coliforms

Area	Variable 1	Variable 2	Number	p-value
Wash Hand Basin in Food Preparation Area	Total bacteria	Presence of basin	97	0.618
	Coliforms	Presence of basin	97	0.924

4.9.6 Association between total bacteria count, coliform count and hygienic status of toilet facilities used by food handlers

At a significance level of 5% the provision of soap and toilet paper in the ablution facilities had no association with total bacteria count and coliform count as indicated by Table 26, except for the provision of nail brush (p=0.037) which reduced the coliform count significantly.

Table 26: Ablution facilities versus numbers of total bacteria and coliforms

Area	Variable 1	Variable 2	Number	p-value
Ablution Facilities	Total bacteria	Provision of soap	88	0.410
	Coliforms	Provision of soap	88	0.394
	Total bacteria	Provision of nail brush	46	0.496
	Coliforms	Provision of nail brush	46	0.037
	Total bacteria	Provision of toilet paper	95	0.449
	Coliforms	Provision of toilet paper	95	0.477

4.9.7 Association between total bacteria count, coliform count and the location of the refuse bin area

At a significance level of 5% the location of the refuse bin area whether it had a direct access or was away from the food preparation area had no association with total bacteria count and coliform count as indicated by Table 27.

Table 27: Location of refuse bin area versus numbers of total bacteria and coliforms

Area	Variable 1	Variable 2	Number	p-value
Location of Refuse Bin Area	Total bacteria	Directly linked to the kitchen	15	0.596
	Coliforms	Directly linked to the kitchen	15	0.840

4.9.8 Association between total bacteria count, coliform count and the provision and accessibility of first aid room or box

At a significance level of 5% the first aid room or box, whether provided or not provided had no association with total bacteria count and coliform count as indicated by table 28.

Table 28: First aid box/room versus numbers of total bacteria and coliforms

Area	Variable 1	Variable 2	Number	p-value
First Aid Room/Box	Total bacteria	Provided and accessible	72	0.829
	Coliforms	Provided and accessible	72	0.812

4.9.9 Association between total bacteria count, coliform count and the pest control measures.

At a significance level of 5% the pest control measures, whether carried out at different intervals or whether there was no service being provided had no association with total bacteria count and coliform count as indicated by table 29.

Table 29: Pest control versus numbers of total bacteria and coliforms

Area	Variable 1	Variable 2	Number	p-value
Pest Control Measures	Total bacteria	Pest control	91	0.067
	Coliforms	Pest control	91	0.133

4.10 SUMMARY

The overall microbiological quality of food served by the take-away food outlets was found within acceptable safety limits. *Escherichia coli, Staphylococcus aureus* and Salmonella spp were not detected in all food products sampled. Total bacteria count and coliform were detected. About eighty percent (76%) of food samples showed high total bacteria count. Out of the 50% of food sampled food products that had coliform, 78% was detected in eaten raw products such as salads. It looks like there was no association between prevalence of pathogens of food from take-away food outlets and the observed cleanliness of preparation areas and food handling practices.

The results indicated that the percentage of food products not meeting the microbiological standards accepted by the Republic of South Africa regarding total bacteria count and coliform (Chapter 1: Table 1) were 76% and 50%, respectively.

CHAPTER 5: DISCUSSION

5.1 INTRODUCTION

In this chapter the results of the study are discussed. The discussion is presented according to each study objective.

5.2 STATE OF HYGIENE OF FOOD PREMISES

In general 94 % of the food premises were found either in a fair, good or excellent condition being acceptable conditions and the other 6% were either found under poor or very poor conditions. 3% of the food shops did not have wash hand basins located in the food preparation areas and 10% of those that were provided with wash hand basins did not have soap for hand washing. 52% did not have nail brushes. The Food by-laws stipulate that wash hand basins with soap and a nail brush must be provided for use by the food handlers. [15]

Research has linked the use of a nail brush with the potential source of infection, for example, if a food handler has open sores, bleeding can occur thus can lead to blood contamination.[17]

Most of the working surfaces were found to be in satisfactory conditions as 99% of the food shops used metal surface for preparing food, which is an acceptable requirement in terms of the Food by-laws and the Food Cosmetics and Disinfectant Act 54 of 1972 (FCD Act), however it was noted that there was a high total bacteria count in these surfaces, thus this area needed a special attention.

All the shops were provided with toilet facilities as well as adequate hand-washing facilities which were separated from the food preparation areas. It was noted that 5% of the toilet facilities were not provided with toilet papers.

The Food by-laws make provision for exemption of the provision of the storage area in a food shop facility. The business owner has to make necessary application and after inspection by an EHP such approval can be granted with conditions.[17] Only 7% of food shops that did not have storage areas and did not have exemption certificates and in some instances conditions were found to be unsatisfactory. About 6% of those that had one, were found to be under unacceptable condition as 0.7% of these areas either had no ceiling boards or were in a state of disrepair. Conditions of this nature might contribute to contamination of food during storage and if not proper washed during preparation can lead to cross-contamination. These unacceptable conditions also encourage pest infestation.

Most of the refuse bin areas were located away from the kitchen as only 15% had direct access to the food preparation areas. The other major objective of hygienic food handling is to avoid contamination food through pest control activity; it was encouraging to note that such an activity was carried out in 91% of the food shops. Pest management in food handling requires special consideration because of the types of pest problems involved and presence of very favourable conditions for pests because of the type of work or operation involved. Facilities that had refuse bin areas with the direct access to the kitchen needs to have proper pest control measures and it was encouraging to note that this control was observed in such food outlets.

5.3 FOOD SAFETY PRACTICES OF FOOD HANDLERS

Ninety one percent (91%) displayed food ready to be served was covered and 96% of the cooked food was well separated from the uncooked food to reduce the risk of cross-contamination.

It was observed that during the sampling period that some of the foods were not kept at required temperatures.

Touching cooked foods with bare hands should be avoided wherever possible as even clean hands can carry pathogenic microorganisms. [17] It was observed during the study that only 14 % of the food handlers wore gloves. The use of gloves is discouraged if there is nobody to monitor the frequency of change. [17]

Food handlers must avoid coughing over food or touching their hair, nose, or mouth while handling food. [19] It was noted that most of the food handlers did observe this as non were observed coughing over food, 97% had short fingernails and 99% had hands free of sores. Ignorance may be the cause of observing 15% of the food handlers found wearing jewellery on their hands whilst handling food and 3% were observed smoking whilst working with food and training can contribute to correct habits.

The Food by-laws at the City of Durban state clearly that every employer must provide protective clothing which is of light coloured material for every employee involved in food preparation, it further states that the employer has to ensure that such clothing is worn at all times. [15] Two percent did not have any form of protective clothing, instead were using their own form of clothing during the food preparation.

Certain hygiene practices that contribute to contamination were observed in some of the food handlers. This was proved by laboratory results as most of the samples had high total aerobic plate count. The reasons may be the raw product was contaminated at the source (the supplier of the product), or at the storage facility, or cross- contamination during preparation or food was not properly washed during preparation, as this total bacterial count was detected mostly in salads.

The World Health Organisation (WHO) has long been aware of the need to educate food handlers about their responsibility for food safety. WHO introduced the five Keys to Safer Food Poster in 2001.[38] The core messages of the Five Keys to Food are:

1 Keep clean;

2 Separate raw and cooked;

3 Cook thoroughly;

4 Keep food at safe temperature; and

5. Use safe water and raw material.[38]

5.4 BACTERIAL QUALITY OF READY-TO-EAT FOOD

Only a small percentage of food samples were tested positive during this investigation however the detection of total bacteria count and the presence of coliform count still present a potential health hazard to consumers. *E. coli, S. aureus* and Salmonella spp. were not detected in any of the food samples that were tested. A high portion of the food samples exceeded the microbiological standards of total bacteria count and coliform counts accepted by this country in terms of the FCD act (Chapter1: Table 1).

5.4.1 Total bacteria count

Seventy six percent (76%) of samples showed high total bacteria count total. Regarding the distribution of microbial population, 13% of the samples were found to have an aerobic count of $>10^5$ cfu/g^{-1}. The high total bacteria count in this study was an indication of unsuitable time/temperature storage conditions, keeping quality of foods and contamination of food through food handling.

5.4.2 Coliform count

The study showed that incidence of coliform was 50%. Out of the 50% of food products that had coliform, 78% was detected in eaten raw products salads. The occurrence of coliforms especially in high numbers such as >6log cfu/g^{-1}, indicates contamination and poor microbiological quality. This can be as a result of contaminated raw products material, cross contamination during preparation.

According to the FCD Act coliform count in cold meal including salad should be < 200/g and *E. coli, S. aureus* and *Salmonella* should not be detected in RTE foods (Table 1). [16] The largest population of distribution for coliforms was found in the range of 10^4 to $<10^5$cfu/ g^{-1}.

Several investigations regarding the microbiological quality of various RTE or ready-to-use food products such as vegetable salads, cold and hot meals served by airlines, street-vended foods,

have been reported. For coliforms, *E. coli* and *S aureus* , the percentage of the 18^0C RTE food accepted by the Republic of China was 75.0%, 7.9% and 17% respectively. [39]

5.5 RELATIONSHIP BETWEEN THE STATE OF HYGIENE OF THE FOOD PREMISES AND THE BACTERIAL CONTENT OF THE FOOD

There was no association at the $p < 0.05$ significant level between the general hygiene of the food shop and the bacterial content of the food. However, Mann-Whitney test at 0.05 significant level to show whether temperature influences the detection of total bacteria count and coliform was very significant with a p value < 0.01. This suggests that presence of coliform and the pathogens detected under total bacteria count in food depend on food storage temperature. High temperatures do not favour the presence of coliform and total bacteria count.

5.6 ASSOCIATION BETWEEN THE FOOD SAFETY PRACTICES OF FOOD HANDLERS AND THE BACTERIAL CONTENT OF THE FOOD

There was no association at the $p < 0.05$ significant level between surface used for food preparation area, protective clothing worn by food handlers and the bacterial content of the food.

5.7 SUMMARY

In this study RTE food products fulfilled the requirements of the FCD Act when total bacteria count, enteric indicator bacteria and *S. aureus*, respectively, were used as indicators. The results of the study indicate that there are some handling practices in the preparation process of RTE foods that require more attention. The survey data described in this report indicate that even though the study was aiming at getting an association by observing and assessing the general hygiene status of the preparation areas and food handlers' personal hygiene status and practices and analysis thereafter of all food samples taken, association was not observed.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 INTRODUCTION

One strategy to reduce food-borne illness involves implementing a food safety education programme for food shop owners, food handlers and consumers. These education programmes should include approaches that focus on reducing the food handling and preparation practices as well as personal hygiene behaviours associated with food-borne diseases.

Improved control can be achieved by prevention of cross-contamination throughout the food chain within the shop area through regular hand washing with soap and water, and by better handling and adequate storage and cooking of food.

6.2 CONCLUSION

6.2.1 Hygiene of food premises

The results of the study indicated that there were high bacterial indicator counts where metal surfaces were used for food preparation. Food shops need to have adequately trained staff and owners needs to show commitment by closely monitoring all the facilities and activities within their business. Shop owners must have an easy to monitor cleaning system that will be user friendly to staff. Constant cleaning with sanitizers accompanied with proper training will adequately resolve this problem.

6.2.2 Food safety practices by food handlers

Control in food handling needs to be observed by food handlers as 76% of samples showed total bacterial. It is recommended that food handlers should ideally receive training and education in two aspects of the food safety:

- Principles of good hygiene practice;
- Application of the HACCP concept to food preparation.

Where food handlers are receiving formal education in food preparation, the above two aspects food safety should be included in their curricula. Training in principles of good hygiene practice equip food handlers with the rudiments of food safety whereas training in HACCP helps them to learn to adopt a critical approach thought process and eventually learn to:

- Identify potential hazards and control measures that are relevant, effective and specific to the operation in question and to the work situation;

- Priorities control measures; ensure that the critical ones are applied correctly and that they meet the necessary condition.

Environmental Health Specialists Network conducted systematic environmental evaluation in 22 restaurants. Bare-hands contact with food (35%) was the most commonly identified contributing factors to disease outbreaks. Food safety certification of kitchen managers appeared to be an important outbreak prevention measure, and the study recommended that managing food worker illnesses and food handling practices should be emphasized during food safety training programs. Education is paramount in promoting healthy food handling practices, changing cultural perception of hygiene and hand washing techniques.[22] Among businesses, higher perception among managers of the risk to food safety was significantly related to HACCP use ($P < 0.005$).[40]

6.2.3 Bacterial quality of food stuffs

There must be adequate control measures at all points in the food chain at which microbial hazards can occur. For example, the wearing of appropriate protective clothing for examples gloves during food preparation, regular washing of hands with soap and water and the maintenance of the required temperature for sufficient time to inactivate micro organisms and their toxins is vital.

Shop owners should be encouraged to implement technologies that prevent contamination that control microbial growth and that remove or kill microorganisms in food during the food preparation especially the food eaten raw.

6.3 RECOMMENDATIONS FOR IMPROVEMENT OF SERVICE

6.3.1 Service provider

eThekwini Municipality Health Department(EMHD) needs to embark on a health education campaign that will address all the problematic areas identified in this report. The content of such a campaign should focus on awareness of risks from food-borne illness; the importance of keeping the preparation areas and other facilities used in food business clean, and enhance shop owners and food handlers' knowledge on food safety. Factors that contribute to outbreaks of food-borne illnesses should be stressed, so that proper control measures based on the HACCP principle can be introduced.

It is recommended that Environmental Health Practitioners (EHP's) should make use of the Five Keys to Safer Food Manual at www.who.int/foodsafety/consumer/5keys/en/index.html as a guide for training purposes, on principles of good hygiene practices. The Manual is divided into two sections. Section one is the background Material and section two is the Five Keys to Safer Food. Section two elaborates the core food safety information provided in the WHO Five Keys to Safer Food Poster (Annexure 12) and suggests how to communicate these messages.[38]

When food handlers lack professional training and qualification, its may be difficult to train them in HACCP. In such cases, it is important to impress on them the value of this technique. EHP's could assist in conducting HACCP studies by identifying hazards, appropriate control measures, critical control points, critical limits and corrective measures and train food handlers in the outcome of these studies.

The success of such training programmes rely on well trained personnel, EHP's need to be engaged and continuously be offered opportunities to attend courses on food safety that will update them on new disease strains that cause food-borne illnesses and the new technologies that can be applied in food industry to prevent food contamination .

To improve control of food-borne diseases there needs to be enhanced investigation of outbreaks through better coordination of health agencies at different jurisdictional levels (including regular dissemination of materials by means of effective reporting forms), better trained medical personnel, laboratory staff, EHP's and computer networking.

Level of negligence was observed in some of the food shops regarding the maintenance of food shop facilities in satisfactory condition therefore there should be continuous monitoring by EHP's and continuous law enforcement where there is an absolute disregard of the law.

6.3.2 Record keeping

One of the identified problem in this study was that, the system of data capturing was either not functional or very difficult to access, it is recommended that the EMHD should change the record keeping system and design an easy to access system that is user friendly and it should be such that, the department is able to monitor trends for future planning purposes. Such a system can link up with the data base of eThekwini Business Licensing Department.

6.4 RECOMMENDATIONS FOR FURTHER STUDIES

EHP's should actively participate in the surveillance of food-borne diseases. Epidemiological data are needed so that public health authorities can be aware of the kind of diseases that are current in the population, can identify which subgroups are most at risk, can plan the appropriate food safety programmes, and can target educational interventions in an appropriate way. Given the fact that occurrence of food-borne diseases is rare in the Durban area, it is recommended that future studies should work with larger sample sizes.

6.5 FEEDBACK

Feedback on the findings of the study will be given to the Management of the eThekwini Municipality Health Department.

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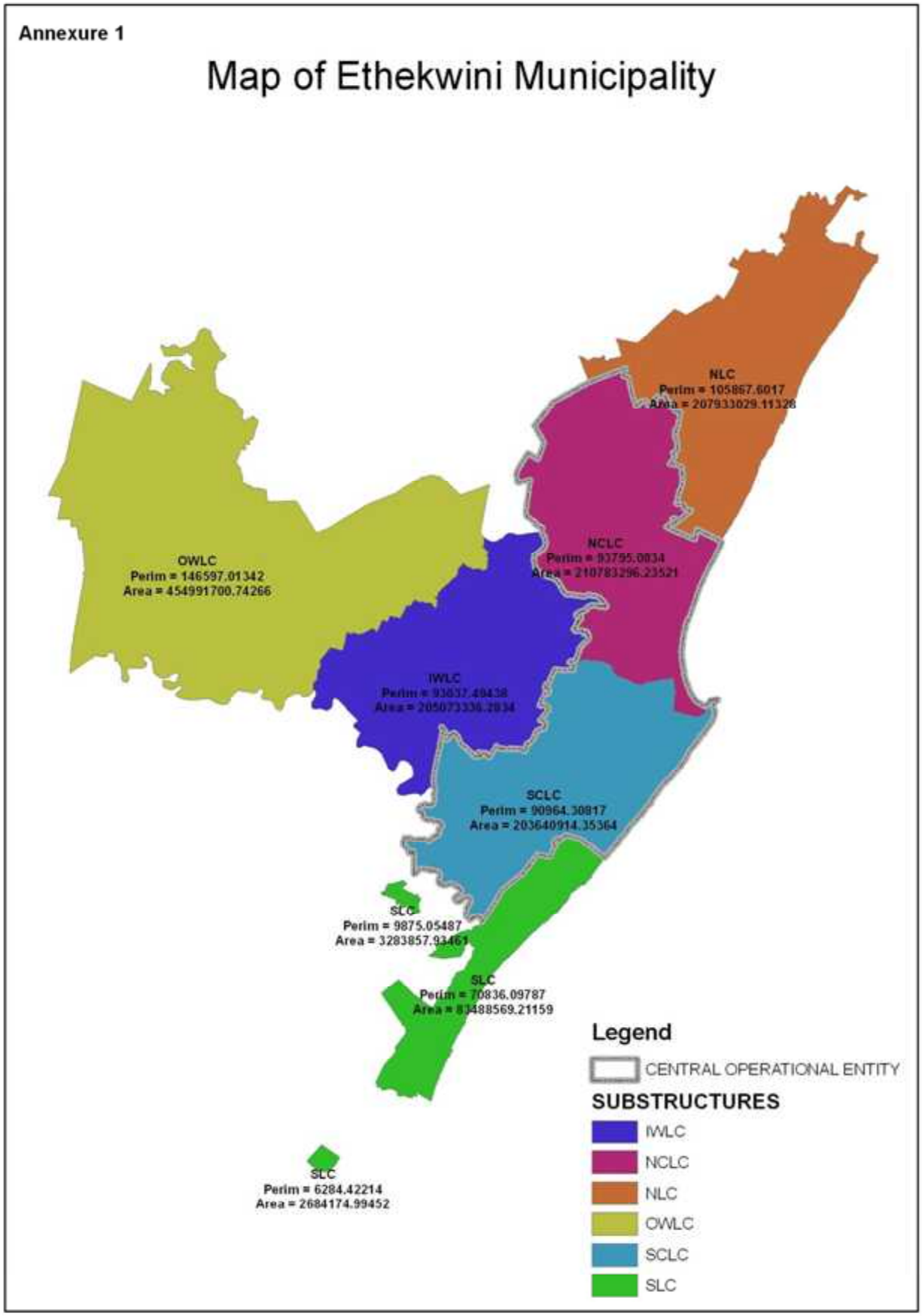
Annexure 1: Map of eThekwini Municipality



Annexure 2 : Food Shop Observational Checklist Form

Premises No.: _____

FOOD SHOP CHECKLIST

9 Old Fort Place
DURBAN
4000

TEL: 031-3003911

IDENTIFICATION NUMBER

TRADE NAME OF PREMISES : _____

PHYSICAL ADDRESS OF PREMISES : _____

_____

TEL NO.: CODE: _____ NUMBER: _____

CELL NO.: _____

CERTIFICATE OF ACCEPTABILITY NO.: _____

OWNERS NAME: _____

RESPONDENT REMARKS: _____

_____

INTERVIEWER REMARKS: _____

_____

INTERVIEWER: _____ DATE COMPLETED: _____

TIME OF INSPECTION:

10H00 <	1
10H01 – 13H00	2
13H01 – 16H30	3

FOOD SHOP HYGIENE

QUALITY OBSERVATION CHECKLIST

Inspected on: _____

	A Serving/Shop Area	B Food Preparation Area	C Storage	D Ablution Facility
Wall surfaces 1				
Floor surface 2				
Equipment 3				
Sinks 4				
Ceiling 5				
Working surfaces 6				

KEY: 1 Very poor
2 Poor
3 Fair
4 Good
5 Excellent
6 Not provided

1. Type of foodstuffs involved (as observed by inspector)

_____

2. Working surfaces used for the preparation of foodstuffs

(a)	Metal	1
(b)	Wood	2
(c)	Plastic	3
(d)	Glass	4
(e)	Cloth	5
(f)	Other (specify)	6

3. Protective clothing worn by food handlers:

(a)	Full Apron	1
(b)	Half apron	2
(c)	Overall	3
(e)	Gloves	4
(f)	Hair cover	5
(g)	None	6

4. The hygienic status of the food handler/s

		Yes	No
(a)	Short / clean nails	1	2
(b)	Hands free of sores	1	2
(c)	Smoking while working with food	1	2
(d)	Coughing over food	1	2
(e)	Jewellery / bangles on the arms	1	2
(f)	Other (Specify) _____	1	2

5. Is the cooked food on display covered

(a)	Yes	1
(b)	No	2

6. Is the cooked and uncooked food stored separately

(a)	Yes	1
(b)	No	2

7. Is a wash hand basin provided for food handlers

(a)	Yes	1
(b)	No	2

If yes is it provided with:

	Yes	No
Soap	1	2
Nail brush	1	2

8.	Are toilet facilities provided with:		
(a)	Soap	- Yes	1
		- No	2
(b)	Nail brush	- Yes	1
		- No	2
(c)	Toilet paper	- Yes	1
		- No	2

9.	Location of the refuse bin area	
(a)	Direct access to the kitchen	1
(b)	Away from the kitchen	2
(c)	Not provided	3

10.	Is a First Aid room/box provided?	
(a)	Yes	1
(b)	No	2

11.	If yes is it accessible to all employees	
(a)	Yes	1
(b)	No	2

12.	Pest Control	
(a)	Yes	1
(b)	No	2

13.	How Often	
(a)	Once a year	1
(b)	Once in six months	2
(c)	Other (specify)	3

NAME of EHP: _____

Thank you for your co-operation

Annexure 3 : Food Sample Form

ETHEKWINI MUNICIPALITY LABORATORY SERVICE

FOOD SAMPLE FORM

FILE REF:_____

_____

ADDRESS TO WHICH REPORT MUST BE SENT

_____

_____

_____

DATE WHEN SAMPLE TAKEN: _____ LAB No.:_____

DATE WHEN SUBMITTED TO LABORATORY: _____

NAME OF CONTACT PERSON: _____

TELEPHONE NUMBER: _____ FAX NUMBER: _____

REMARKS:_____

_____

POSTAL CODE: _____

PHONE NO.: _____

E.H.P. CODE NO. _____

ZONE: _____

SAMPLE DETAILS Unsatisfactory results are highlighted and must be attended to immediately				Temp. when sample taken (°C)	Temp. of food on arrival at Lab (°C)	**FOOD RESULTS : (FOR LABORATORY USE ONLY)** TEST NAME				
Sample No.	Name and address of premises	Product	Main Ingredient			Total Count/g	Coli-form/g	E.Coli (Type 1)	Staph. aureus/g	Salmon-ella/g

DIVISIONAL MANAGER : FOOD CONTROL : **MR U SINGH**
Tel: (031) 3003075

SIGNATURE: _____

LAB. TECHNOLOGIST: **MRS A PATHER**

SIGNATURE:
_____

THIS MUST BE COMPLETED BY AN ENVIRONMENTAL HEALTH PRACTITIONER

Annexure 4: Food Shop Observational Checklist with Score

Premises No.: _____

FOOD SHOP CHECKLIST

9 Old Fort Place
DURBAN
4000

TEL: 031-3003911

IDENTIFICATION NUMBER

TRADE NAME OF PREMISES : _____

PHYSICAL ADDRESS OF PREMISES : _____

_____

TEL NO.: CODE: _____ NUMBER: _____

CELL NO.: _____

CERTIFICATE OF ACCEPTABILITY NO.: _____

OWNERS NAME: _____

RESPONDENT REMARKS: _____

_____

INTERVIEWER REMARKS: _____

_____

INTERVIEWER: _____ DATE COMPLETED: _____

TIME OF INSPECTION:

10H00 <	1
10H01 – 13H00	2
13H01 – 16H30	3

FOOD SHOP HYGIENE

QUALITY OBSERVATION CHECKLIST

Inspected on: _____

	A Serving/Shop Area	B Food Preparation Area	C Storage	D Ablution Facility	Mean
Wall surfaces					
Floor surface					
Equipment					
Sinks					
Ceiling					
Working surfaces					
mean					5(Maximum)

KEY: 1 Very poor
2 Poor
3 Fair
4 Good
5 Excellent

1. Type of foodstuffs involved (as observed by inspector)

_____

2. Working surfaces used for the preparation of foodstuffs

		Score
(a)	Metal	1
(b)	Wood	0
(c)	Plastic	1
(d)	Glass	1
(e)	Cloth	0
(f)	Other (specify)	

3.	Protective clothing worn by foodhandlers:		Score
(a)	Full Apron	1	1
(b)	Half apron	2	1
(c)	Overall	3	1
(e)	Gloves	4	1
(f)	Hair cover	5	1
(g)	None	6	

4. The hygienic status of the food handler/s

		Yes	No	Score
(a)	Short / clean nails	1	2	1
(b)	Hands free of sores	1	2	1
(c)	Smoking while working with food	1	2	1
(d)	Coughing over food	1	2	1
(e)	Jewellery / bangles on the arms	1	2	1
(f)	Other (Specify) _____	1	2	

5. Is the cooked food on display covered

(a)	Yes	1	1
(b)	No	2	0

6. Is the cooked and uncooked food stored separately

(a)	Yes	1	1
(b)	No	2	0

7. Is a wash hand basin provided for food handlers

(a)	Yes	1	1
(b)	No	2	0

If yes is it provided with:

	Yes	No	Score
Soap	1	2	1
Nail brush	1	2	1

8.	Are toilet facilities provided with:			
(a)	Soap	- Yes	1	1
		- No	2	0
(b)	Nail brush	- Yes	1	1
		- No	2	0
(c)	Toilet paper	- Yes	1	1
		- No	2	0

9.	Location of the refuse bin area		
(a)	Direct access to the kitchen	1	0
(b)	Away from the kitchen	2	1
(c)	Not provided	3	0

10.	Is a First Aid room/box provided?		
(a)	Yes	1	1
(b)	No	2	0

11.	If yes is it accessible to all employees		
(a)	Yes	1	1
(b)	No	2	0

12.	Pest Control		
(a)	Yes	1	1
(b)	No	2	0

13.	How Often		
(a)	Once a year	1	0
(b)	Once in six months	2	1
(c)	Other (specify)	3	0

NAME of EHP: _____

Thank you for your co-operation

Annexure 5: Instruction Document

INSTRUCTIONS TO INTERVIEWERS

1. Bear in mind you will be representing the eThekwini Municipality Health Department in this survey. Please conduct yourself accordingly.
2. All fieldwork will be checked by the researcher.
3. A questionnaire must be completed at the business address as stipulated at the training session. Substitution of respondents is not allowed under any circumstances without the permission of the researcher. If a respondent refuses to cooperate, state these facts to the researcher.
4. Interview the owner/manager of the business; conduct the interview at the business site which qualifies to be included as a sample unit in the survey. Hand the respondent your letter of introduction or read it out if necessary. Confirm to the respondent (owner/manager) that the information supplied will be treated strictly confidential.
5. Follow the instructions to the interviewers to ensure that the relevant questions are asked according to sequence. Indicate the response by means of a (√) or circle in the blocks provided.
6. Go through a completed checklist again to make sure that you have not skipped any questions.
7. At least 5 (five) checklists / questionnaires per day should be completed.

DEFINITION OF A TAKE AWAY

For the purpose of this study a take-away includes:

A fast food outlet where food is prepared and sold to the public and sitting areas for onsite consumption of food are not provided.

Annexure 6: Ethical Approval

UNIVERSITY OF
KWAZULU-NATAL

22 June 2005

Mrs A P R Cele
46 Crookit Avenue
WESTRIDGE
4091

e-mail : celea@durban.gov.za

Dear Mrs Cele

PROTOCOL : The microbiological quality and safety of perishable food sold by take-aways in the Durban area. A P R Cele, Community Health. Ref.: H003/05

The Biomedical Research Ethics Committee considered the abovementioned application and the protocol was approved at its meeting held on 25 January 2005 pending appropriate answers to queries raised and approval by the Postgraduate Education Committee. These conditions have now been met, the study is given full ethics approval and may begin as at today's date : 22 June 2005.

This approval is valid for one year from 25 January 2005. To ensure continuous approval, an application for recertification should be submitted a couple of months before the expiry date.

May I take this opportunity to wish you everything of the best with your study. Please send the Biomedical Research Ethics Committee a copy of your report once completed.

Yours sincerely

PROFESSOR A DHAI
Chair : Biomedical Research Ethics Committee

c.c. Dr N Gqaleni, Centre for Environmental Health
Mr S Siboto, Postgraduate Education

Nelson R Mandela School of Medicine, Faculty of Health Sciences,
Head: Bioethics, Medical Law and Research Ethics

Postal Address: Private Bag 7, Congela 4013, South Africa

Telephone: +27 (0)31 260 4604 **Facsimile:** +27 (0)31 260 4529 **Email:** dhaia1@ukzn.ac.za **Website:** www.ukzn.ac.za

Founding Campuses: Edgewood Howard College Medical School Pietermaritzburg Westville

Annexure 6: Ethical Approval

UNIVERSITY OF
KWAZULU-NATAL

22 June 2005

Mrs A P R Cele
46 Crookit Avenue
WESTRIDGE
4091

e-mail : celea@durban.gov.za

Dear Mrs Cele

PROTOCOL : The microbiological quality and safety of perishable food sold by take-aways in the Durban area. A P R Cele, Community Health. Ref.: H003/05

The Postgraduate Education Committee considered the abovementioned application and the protocol is approved for your MPH degree.

May I take this opportunity to wish you every success with your study.

Yours sincerely

M. Adhikari

PROFESSOR M ADHIKARI
Chair : Postgraduate Education Committee

c.c. Dr N Gqaleni, Centre for Environmental Health
Mr S Siboto, Postgraduate Education

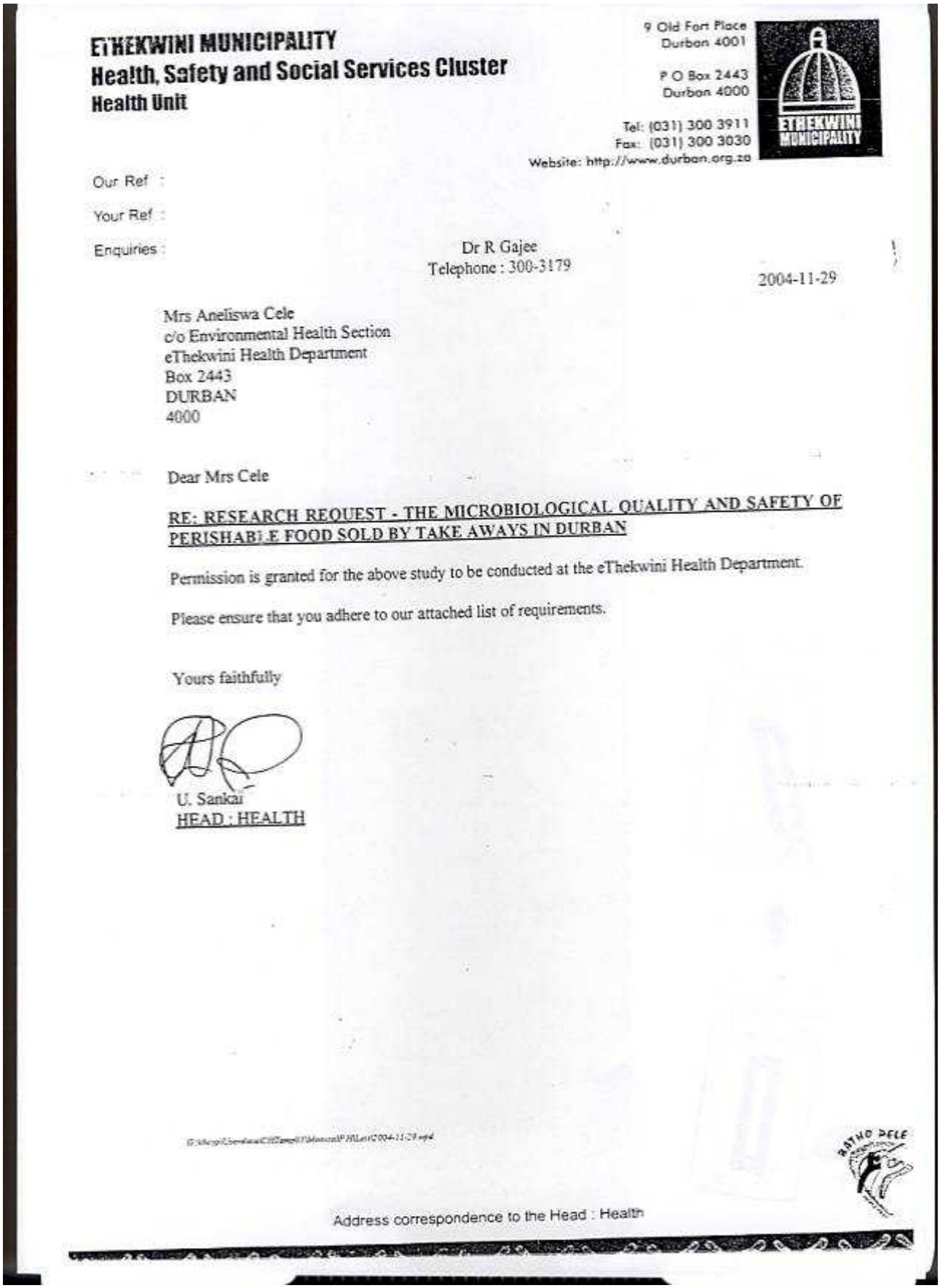
Nelson R Mandela School of Medicine, Faculty of Health Sciences, Medical Research Administration

Postal Address: Private Bag 7, Congella 4013, South Africa

Telephone: +27 (0)31 260 4495 **Facsimile:** +27 (0)31 260 4529 **Email:** borresen@ukzn.ac.za **Website:** www.ukzn.ac.za

Founding Campuses: Edgewood Howard College Medical School Pietermaritzburg Westville

Annexure 7: Permission to Conduct a Study from eThekwini Health Department



ETHEKWINI MUNICIPALITY
Health, Safety and Social Services Cluster
Health Unit

9 Old Fort Place
Durban 4001

P O Box 2443
Durban 4000

Tel: (031) 300 3911
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Website: http://www.durban.org.za

Our Ref :

Your Ref :

Enquiries : Dr R Gajee
Telephone : 300-3179

2004-11-29

Mrs Aneliswa Cele
c/o Environmental Health Section
eThekwini Health Department
Box 2443
DURBAN
4000

Dear Mrs Cele

RE: RESEARCH REQUEST - THE MICROBIOLOGICAL QUALITY AND SAFETY OF PERISHABLE FOOD SOLD BY TAKE AWAYS IN DURBAN

Permission is granted for the above study to be conducted at the eThekwini Health Department.

Please ensure that you adhere to our attached list of requirements.

Yours faithfully

U. Sankai
HEAD : HEALTH

Address correspondence to the Head : Health

Annexure 7: Permission to Conduct a Study from eThekwini Health Department

ETHEKWINI MUNICIPALITY
Health Department

9 Old Fort Place
Durban 4001
P O Box 2443
Durban 4000
Tel: (031) 300 3911
Fax: (031) 300 3030

Our Ref:
Your Ref:
Enquiries: Dr R Gajee
Telephone: 300-3179

Dear Sir/Madam

RE : RESEARCH REQUEST

The following requirements need to be complied with before permission is granted for you to undertake research in this department.

1. A full written protocol, with written proof of approval by an accredited Ethics Committee (NB. This will also be required for changes to research methodology).
2. A briefing meeting with relevant staff, or community if indicated.
3. An assurance that our services will not be disrupted.
4. An understanding that participation in your study by members of the public is on a voluntary basis.
5. Compliance with Access to Information Act and other relevant legislation.
6. You will assume full responsibility for obtaining informed/ written consent from the public/ patients, and maintaining confidentially.
7. All drugs used in research trials/studies must be registered with the MCC
8. eThekwini Municipality - Health Department requires indemnity against any claim that may be brought about by researchers/ research workers in terms of the Compensation of Occupational Injuries and Diseases Act.
9. The eThekwini Municipality Health Department requires indemnity against any claims that may arise as a direct or indirect result of any acts or omissions by the research team.
10. Submission of progress reports/ meetings at appropriate intervals, or on request.
11. Obtain prior permission from this Department before press releases, and release of results to communities/ stakeholders.
12. Withdrawal of permission to conduct research will be left to discretion of the eThekwini Health Department.
13. This Department is to receive recognition for the assistance given, and a copy of the research results on conclusion of the study must be submitted before publication.

Having accepted and complied with the above terms, you will then be informed of the outcome of your request.

Yours faithfully

pp U. Sankar
HEAD : HEALTH

Address correspondence to the Director: Health

Annexure 8: Information Document

INFORMATION DOCUMENT FOR STUDY PARTICIPANTS

STUDY TITLE:

An investigation into the microbiological quality and safety of perishable food sold by take-away food outlets in Durban area.

GREETING:

Good Day

INTRODUCTION:

My name is …….. an Environmental Health Practitioner (EHP) of eThekwini Municipality Health Department.

I am here in my official capacity as well as assisting my colleague, Aneliswa Cele, who is currently conducting a study for her Masters Degree in Public Health and this exercise is also part of my official duties.

This is an official inspection of your premises in terms of Food, Cosmetic and Disinfectants Act, Act 54 of 1972 (FCD Act). In addition to the inspection, a colleague would like to use information from this inspection for research purposes. I am requesting you to take part in the research project.

What is involved in the study :

As a participant you are expected to avail yourself for the duration of this inspection or you can delegate somebody to assist. Data collection will be conducted as part of the official duties, but data analysis will enable the Researcher to achieve the objectives of the study.

Sampling will be undertaken by myself, I am a duly authorized/qualified EHP. Authorization is in terms of the FCD Act (Regulation regarding Powers, Duties and Functions of Inspectors), as well as relevant academic credentials. Furthermore the samples taken and analysis thereof will be in terms of the said act. All statutory/regulatory criteria will be strictly adhered to in terms of prescribed procedures.

Standard procedures being done in the study

Ready-to-eat food samples will be purchased from your premises and sampling will be conducted according to FCD Act. Prior to sampling the holding temperature of food will be measured. The sample will then be transported to the microbiology laboratory of eThekwini Municipality placed in a cooler box with ice, where the analysis will be conducted by a qualified Laboratory Technologist.

All glassware used in the testing is autoclaved under the supervision of the Laboratory Technologist in order to ensure that it is sterilized before use. The contents of the test and remaining foodstuffs not utilized in the analysis will be suitably secured, sealed and disposed of by the Laboratory personnel (Laboratory Assistant) in an appropriate refuse facility which is in a secured area, free of public access within the premises of eThekwini Health Department. The refuse will be collected by the truck from Durban Solid Waste Department (DSW) which comes twice a week, after which it will then be transported to the Municipal Land Fill site at Bisasar Road, Springfield. The disposal will be done under security and supervision of DSW.

The method of observation will also be used to conduct this study. This will entail an EHP visually inspecting your premises and rating such inspection in a check list . The end result will enable the Researcher to give an overall rating of the quality of hygiene standards of all the food shops in Durban.

Procedures that are being tested

(a) Microbiological quality of food.

(b) Safety of food by observing your food handlers, looking at practices which have a potential threat to food quality/standards which can lead to contamination.

Number of people that will take part in the study

Hundred food shop owners or managers and fourteen qualified Environmental Health Practitioners.

Risk of being involved in the study

None

Benefits of being in the study :

The benefits to you as the owner of a take-away food outlet may be twofold:

Firstly, should the results of the study indicate that bacteria and food quality is satisfactory, this information may be beneficial in that official publications could be used as an advertising mechanism for the eThekwini Municipality as a whole, indicating a superior food quality standard amongst the food outlets with the city.

Secondly, should the results indicate otherwise, the study will then emphasis remedial measures and advise on improving food quality and safety. This will prove a valuable tool in the operation of a safe and healthy food outlet. However, it is important to note that the Department reserves the right to take legal action in the event of any examination of the product sold by yourself disclosing bacterial contamination in contravention of prescribed standards.

Participation is voluntary

The study will be conducted in partial fulfillment of the requirements for a Degree of Masters in Public Health for my colleague, it is important to note that I am conducting this inspection as part of my official duties. Participation in the research however, is voluntary, your will not be penalized if you refuse to participate and you may discontinue participation at any time.

Confidentiality

Efforts will be made to keep personal information confidential. Absolute confidentiality cannot be guaranteed. Personal information may be disclosed if required by law. Section 16 of the FCD Act (Regulation regarding Preservation of Secrecy) protects the professional confidentiality between the EHPs and the details of food premises. For the purposes of this research, this legislation is upheld and any access by anyone to obtain such confidential details from the researcher or other participants is forbidden.

Annexure 9: Consent document

CONSENT DOCUMENT

Consent to Participate in Research

I have read this form, or had it read to me, and voluntarily agree to participate in a research study. The purpose of the study, the procedures, and the risks and benefits have been explained to my satisfaction. My signature indicates that I consent participation to the research study.

_____ _____

Signature of Participant Date

_____ _____

Signature of Witness Date

(Where applicable)

_____ _____

Signature of Translator Date

(Where applicable)

Annexure 10: Types of samples taken from take-away food outlets as well as holding temperatures recorded per sample, in the eThekwini Municipality, Central Operational Entity, Durban, 2005

Premises Code	Laboratory Sample Number	Brief Description of Product	Holding Temperature (°C)	Temperature on Arrival at Laboratory (°C)
	001			
1	6	Coleslaw	8	5
2	7	Coleslaw	8	7
3	8	Rice	65	22
4	9	Savoury rice	48	20
5	10	Mashed potato	18	11
6	1	Sambals	7	5
7	2	Sambals	18	9
8	3	Lettuce and tomato salad	17	8
9	4	Chicken and mayonnaise salad	14	8
10	5	Coleslaw	6	5

Premises Code	Laboratory Sample Number	Brief Description of Product	Holding Temperature (°C)	Temperature on Arrival at Laboratory (°C)
	002			
11	1	Coleslaw	6	5
12	2	Pasta salad	5	5
13	3	Lettuce salad	8	8
14	4	Greek salad	7	6
15	5	Rice	61	32
16	1	Broad bean curry	63	25
17	2	Vegetable breyani	61	41
18	3	Carrot salad	19	10
19	4	Rice	60	31
20	5	Rice	62	31

Premises Code	Laboratory Sample Number	Brief Description of Product	Holding Temperature (°C)	Temperature on Arrival at Laboratory (°C)
	003			
21	1	Greek salad	10	14
22	2	French salad	15	14
23	3	Fresh mushroom slices	10	14
24	4	Tomato slices	10	14
25	5	Greek salad	9	14
26	7	Mediterranean pasta	7	16
27	8	Cheese and tomato sandwich	51	16
28	9	Chicken and mayonnaise sandwich	8	16
29	10	Tuna and mayonnaise sandwich	8	16
30	11	Coleslaw	7	16

Premises Code	Laboratory Sample Number	Brief Description of Product	Holding Temperature (°C)	Temperature on Arrival at Laboratory (°C)
	004			
31	1	Coleslaw	7	7
32	2	Beef curry	65	42
33	3	Beef curry	8	7
34	4	Fish	65	42
35	5	Chips (fried)	62	21
36	6	Beans curry	65	41
37	7	Chicken curry	65	22
38	6	Coleslaw	7	7
39	7	Chips (fried)	65	23
40	8	Chicken curry	54	7

Premises Code	Laboratory Sample Number	Brief Description of Product	Holding Temperature (°C)	Temperature on Arrival at Laboratory (°C)
	005			
41	8	Chicken curry	60	25
42	9	Mutton curry	70	31
43	10	Sausage	13	9
44	11	Fish (fried)	71	21
45	12	Fish curry	50	18
46	1	Fried fish	10	8
47	2	Fried boerewors	18	10
48	3	Fried mince	61	19
49	4	Fried chicken	65	19
50	5	Roast beef	7	7

Premises Code	Laboratory Sample Number	Brief Description of Product	Holding Temperature (°C)	Temperature on Arrival at Laboratory (°C)
	006			
51	18	Vegetable pickles	6	5
52	19	Rice	54	8
53	20	Lettuce	9	6
54	21	Shredded lettuce	7	5
55	22	Mutton curry	77	10
56	6	Coleslaw	9	6
57	7	Mutton curry	80	6
58	8	Vegetable salad	9	4
59	9	Vegetable salad	6	5
60	10	Mutton curry	75	7

Premises Code	Laboratory Sample Number	Brief Description of Product	Holding Temperature (°C)	Temperature on Arrival at Laboratory (°C)
	007			
61	13	Tomato sambals	10	17
62	14	Carrot sambals	9	17
63	15	Carrot sambals	16	17
64	16	Carrot sambals	11	17
65	17	Chicken and mayonnaise salad	15	17
66	18	Carrot sambals	9	17
67	9	Coleslaw	11	9
68	10	Carrot salad	10	9
69	11	Carrot salad	15	9
70	12	Carrot salad	7	9

Premises Code	Laboratory Sample Number	Brief Description of Product	Holding Temperature (°C)	Temperature on Arrival at Laboratory (°C)
	008			
71	1	Rice	82	54
72	2	Rice	64	5
73	3	Green salad	14	5
74	4	Ice cream	0	5
75	5	Coleslaw salad	5	5
76	6	Spice chicken	10	5
77	7	Rice	65	5
78	8	Greek salad	8	5
79	9	Chicken	8	5
80	10	Greek salad	7	5

Premises Code	Laboratory Sample Number	Brief Description of Product	Holding Temperature (°C)	Temperature on Arrival at Laboratory (°C)
	009			
81	11	Savoury Rrice	74	27
82	12	Rice	75	32
83	13	Savoury rice	93	27
84	5	Rice	70	27
85	6	Cubed beef	17	7
86	7	Coleslaw	15	6
87	8	Chicken	4	7

Premises Code	Laboratory Sample Number	Brief Description of Product	Holding Temperature (°C)	Temperature on Arrival at Laboratory (°C)
	010			
88	1	Chicken kebaab	65	7
89	2	Chicken stir fry	65	7
90	3	Bean curry	65	7
91	4	Beef curry	63	7
92	5	Vegetable curry	63	7
93	14	Bean curry	53	7
94	15	Bean curry	65	7
95	16	Bean curry	65	7
96	17	Savoury rice	65	7
97	18	Fried chips	65	7
98	1	Beans curry	67	7
99	2	Chicken curry	95	7
100	3	Fried chips	66	7

Annexure 11: Results of Microbiological Analysis. Counts in colony-forming units per gram (CFU/g) and presence or absence of microorganisms tested for in perishable food products from take-away food outlets sampled in the eThekwini Municipality, Central Operational Entity, Durban, 2005

Premises Code	Laboratory Sample Number	TAPC[a]	CC[b]	*Escherichia coli*	*Staphylococcus aureus*	*Salmonella*
	001					
001	6	110,000	30,000	nd[c]	<10	-[e]
2	7	450,000	40,000	nd	<10	-
3	8	<10[d]	<10	nd	<10	-
4	9	<10	<10	nd	<10	-
5	10	<10	<10	nd	<10	-
6	1	20,000	<10	nd	<10	-
7	2	60,000	1,000	nd	<10	-
8	3	100,000	8,000	nd	<10	-
9	4	60,000	500	nd	<10	-
10	5	60,000	300	nd	<10	-

a: Total aerobic plate count
b: Coliform count
c: Not detected
d: Both plates containing no colonies/ no characteristics colonies at first dilution given as< 10
e: Absent from the sample size tested

Premises Code	Laboratory Sample Number	TAPC[a]	CC[b]	*Escherichia coli*	*Staphylococcus aureus*	*Salmonella*
	002					
11	1	>1,000,000	<10	nd[c]	<10	-[e]
12	2	100	<10	nd	<10	-
13	3	1,000	90,000	nd	<10	-
14	4	300	110,000	nd	<10	-
15	5	<10[d]	<10	nd	<10	-
16	1	<10	<10	nd	<10	-
17	2	10,000	<10	nd	<10	-
18	3	>500,000	>500,000	nd	<10	-
19	4	30,000	<10	nd	<10	-
20	5	>300,000	20,000	nd	<10	-

a: Total aerobic plate count
b: Coliform count
c: Not detected
d: Both plates containing no colonies/ no characteristics colonies at first dilution given as< 10
e: Absent from the sample size tested

Premises Code	Laboratory Sample Number	TAPC[a]	CC[b]	*Escherichia coli*	*Staphylococcus aureus*	*Salmonella*
	003					
21	1	300	<10	nd[c]	<10	-[e]
22	2	1,300	70,000	nd	<10	-
23	3	500	>500,000	nd	<10	-
24	4	<10[d]	500	nd	<10	-
25	5	<10	400	nd	<10	-
26	7	<10	<10	nd	<10	-
27	8	200	<10	nd	<10	-
28	9	10,000	70,000	nd	<10	-
29	10	100	10,000	nd	<10	-
30	11	20,000	600	nd	<10	-

a: Total aerobic plate count
b: Coliform count
c: Not detected
d: Both plates containing no colonies/ no characteristics colonies at first dilution given as< 10
e: Absent from the sample size tested

Premises Code	Laboratory Sample Number	TAPC[a]	CC[b]	*Escherichia coli*	*Staphylococcus aureus*	*Salmonella*
	004					
31	1	190,000	2,100	nd[c]	<10	-[e]
32	2	>500,000	<10	nd	<10	-
33	3	30,000	<10	nd	<10	-
34	4	<10[d]	<10	nd	<10	-
35	5	200	<10	nd	<10	-
36	6	600	<10	nd	<10	-
37	7	100	<10	nd	<10	-
38	6	60,000	30,000	nd	<10	-
39	7	1,600	1,100	nd	<10	-
40	8	60,000	30,000	nd	<10	-

a: Total aerobic plate count
b: Coliform count
c: Not detected
d: Both plates containing no colonies/ no characteristics colonies at first dilution given as< 10
e: Absent from the sample size tested

Premises Code	Laboratory Sample Number	TAPC[a]	CC[b]	*Escherichia coli*	*Staphylococcus aureus*	*Salmonella*
	005					
41	8	200	<10	nd[c]	<10	-[e]
42	9	10,000	<10	nd	<10	-
43	10	10,000	<10	nd	<10	-
44	11	100	<10	nd	<10	-
45	12	10,000	<10	nd	<10	-
46	1	20,000	10,000	nd	<10	-
47	2	10,000	3,200	nd	<10	-
48	3	20,000	10,000	nd	<10	-
49	4	30,000	20,000	nd	<10	-
50	5	10,000	2,200	nd	<10	-

a: Total aerobic plate count
b: Coliform count
c: Not detected
d: Both plates containing no colonies/ no characteristics colonies at first dilution given as< 10
e: Absent from the sample size tested

Premises Code	Laboratory Sample Number	TAPC[a]	CC[b]	*Escherichia coli*	*Staphylococcus aureus*	*Salmonella*
	006					
51	18	320,000	<10	nd[c]	<10	-[e]
52	19	<10[d]	<10	nd	<10	-
53	20	20,000	<10	nd	<10	-
54	21	1,000	<10	nd	<10	-
55	22	<10	<10	nd	<10	-
56	6	80,000	2,200	nd	<10	-
57	7	22,000	<10	nd	<10	-
58	8	10,000	<10	nd	<10	-
59	9	90,000	30,000	nd	<10	-
60	10	30,000	<10	nd	<10	-

a: Total aerobic plate count
b: Coliform count
c: Not detected
d: Both plates containing no colonies/ no characteristics colonies at first dilution given as< 10
e: Absent from the sample size tested

Premises Code	Laboratory Sample Number	TAPC[a]	CC[b]	*Escherichia coli*	*Staphylococcus aureus*	*Salmonella*
	007					
61	13	40,000	10,000	nd[c]	<10	-[e]
62	14	40,000	20,000	nd	<10	-
63	15	50,000	20,000	nd	<10	-
64	16	40,000	10,000	nd	<10	-
65	17	50,000	20,000	nd	<10	-
66	18	30,000	20,000	nd	<10	-
67	9	60,000	20,000	nd	<10	-
68	10	70,000	30,000	nd	<10	-
69	11	60,000	20,000	nd	<10	-
70	12	70,000	20,000	nd	<10	-

a: Total aerobic plate count
b: Coliform count
c: Not detected
d: Both plates containing no colonies/ no characteristics colonies at first dilution given as< 10
e: Absent from the sample size tested

Premises Code	Laboratory Sample Number	TAPC[a]	CC[b]	*Escherichia coli*	*Staphylococcus aureus*	*Salmonella*
	008					
71	1	<10[d]	<10	nd[c]	<10	-[e]
72	2	<10	<10	nd	<10	-
73	3	>500,000	>500,000	nd	<10	-
74	4	<10	<10	nd	<10	-
75	5	250,000	30,000	nd	<10	-
76	6	10,000	<10	nd	<10	-
77	7	<10	<10	nd	<10	-
78	8	>500,000	>500,000	nd	<10	-
79	9	>500,000	>500,000	nd	<10	-
80	10	>500,000	>500,000	nd	<10	-

a: Total aerobic plate count
b: Coliform count
c: Not detected
d: Both plates containing no colonies/ no characteristics colonies at first dilution given as< 10
e: Absent from the sample size tested

Premises Code	Laboratory Sample Number	TAPC[a]	CC[b]	*Escherichia coli*	*Staphylococcus aureus*	*Salmonella*
	009					
81	11	100	<10	nd[c]	<10	-[e]
82	12	<10[d]	<10	nd	<10	-
83	13	<10	<10	nd	<10	-
84	5	60,000	30,000	nd	<10	-
85	6	30,000	20,000	nd	<10	-
86	7	40,000	10,000	nd	<10	-
87	8	20,000	10,000	nd	<10	-

a: Total aerobic plate count
b: Coliform count
c: Not detected
d: Both plates containing no colonies/ no characteristics colonies at first dilution given as< 10
e: Absent from the sample size tested

Premises Code	Laboratory Sample Number	TAPC[a]	CC[b]	*Escherichia coli*	*Staphylococcus aureus*	*Salmonella*
	010					
88	1	400	<10	nd[c]	<10	-[e]
89	2	<10[d]	<10	nd	<10	-
90	3	<10	<10	nd	<10	-
91	4	200	<10	nd	<10	-
92	5	<10	<10	nd	<10	-
93	14	<10	<10	nd	<10	-
94	15	100	<10	nd	<10	-
95	16	<10	<10	nd	<10	-
96	17	<10	<10	nd	<10	-
97	18	<10	<10	nd	<10	-
98	1	30,000	20,000	nd	<10	-
99	2	300	100	nd	<10	-
100	3	400	100	nd	<10	-

a: Total aerobic plate count
b: Coliform count
c: Not detected
d: Both plates containing no colonies/ no characteristics colonies at first dilution given as< 10
e: Absent from the sample size tested

Annexure 12: WHO Five Keys to Safer Food Poster

Five keys to safer food

Keep clean

- Wash your hands before handling food and often during food preparation
- Wash your hands after going to the toilet
- Wash and sanitize all surfaces and equipment used for food preparation
- Protect kitchen areas and food from insects, pests and other animals

Why?

While most microorganisms do not cause disease, dangerous microorganisms are widely found in soil, water, animals and people. These microorganisms are carried on hands, wiping cloths and utensils, especially cutting boards and the slightest contact can transfer them to food and cause foodborne diseases.

Separate raw and cooked

- Separate raw meat, poultry and seafood from other foods
- Use separate equipment and utensils such as knives and cutting boards for handling raw foods
- Store food in containers to avoid contact between raw and prepared foods

Why?

Raw food, especially meat, poultry and seafood, and their juices, can contain dangerous microorganisms which may be transferred onto other foods during food preparation and storage.

Cook thoroughly

- Cook food thoroughly, especially meat, poultry, eggs and seafood
- Bring foods like soups and stews to boiling to make sure that they have reached 70°C. For meat and poultry, make sure that juices are clear, not pink. Ideally, use a thermometer
- Reheat cooked food thoroughly

Why?

Proper cooking kills almost all dangerous microorganisms. Studies have shown that cooking food to a temperature of 70°C can help ensure it is safe for consumption. Foods that require special attention include mince dishes, rolled roasts, large joints of meat and whole poultry.

Keep food at safe temperatures

- Do not leave cooked food at room temperature for more than 2 hours
- Refrigerate promptly all cooked and perishable food (preferably below 5°C)
- Keep cooked food piping hot (more than 60°C) prior to serving
- Do not store food too long even in the refrigerator
- Do not thaw frozen food at room temperature

Why?

Microorganisms can multiply very quickly if food is stored at room temperature. By holding at temperatures below 5°C or above 60°C, the growth of microorganisms is slowed down or stopped. Some dangerous microorganisms still grow below 5°C.

Use safe water and raw materials

- Use safe water or treat it to make it safe
- Select fresh and wholesome foods
- Choose foods processed for safety, such as pasteurized milk
- Wash fruits and vegetables, especially if eaten raw
- Do not use food beyond its expiry date

Why?

Raw materials, including water and ice, may be contaminated with dangerous microorganisms and chemicals. Toxic chemicals may be formed in damaged and mouldy foods. Care in selection of raw materials and simple measures such as washing and peeling may reduce the risk.

Food Safety
World Health Organization

Knowledge = Prevention