THE MICROBIOLOGICAL QUALITY OF FOOD FROM STREET VENDORS IN THE CITY OF BLOEMFONTEIN AND ASSOCIATED HYGIENE PRACTICES

by

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DECLARATION OF INDEPENDENT WORK

I, **MPELI RETHABILE RASEPHEI**, do hereby declare that this research project submitted to the Central University of Technology, Free State for the degree MAGISTER TECHNOLOGIAE: ENVIRONMENTAL HEALTH, is my own independent work that has not been submitted before to any institution by myself or any other person in fulfilment of the requirements for the attainment of any qualification.

M Rasephei ..... 12 MAY 2005

SIGNATURE OF STUDENT **DATE**

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SUMMARY

The study investigated the indicator organisms and pathogens on beef, chicken and gravy as well as on the hands and food preparation surfaces of street food vendors in the city of Bloemfontein, South Africa. Furthermore, the bacterial counts were compared with national guidelines as well as with infective dose limits. Finally, the food handlers' knowledge and practices regarding the safety of food were assessed and conclusions made as to the relationship between specific practices and the resulting microbiota. Samples of beef, chicken and gravy as well as from hands and preparation surfaces were collected from street food vendors and analysed for total viable counts, Coliforms, *Escherichia coli*, *Staphylococcus aureus*, presumptive *Salmonella* spp., *Listeria monocytogenes*, yeasts and moulds. Microbial loads on surfaces were found to be relatively low throughout and counts from the food were without exception inside the infective dose limit, although some exceeded the national guidelines. *Listeria monocytogenes* was not detected in any of the food samples.

For determining the respondents' food safety knowledge and practices, a structured questionnaire and a checklist were applied. Food storage seemed to be a serious problem in the study area because none of the vendors had refrigerators. Another notable observation was that none of the food handlers appeared to have any formal knowledge of

proper hygienic methods of food preparation. A lack of basic infrastructure to support practices such as sanitation and washing furthermore existed. Investigations into the inter-relationships amongst the various microbiota as well as between selected microbiota and food handler practices revealed that a definite link exists between the predominance of indicator bacteria generally used as indicators of food safety in the formal sector. Relationships between selected food handler practices and microbiota were furthermore eminent in the case of chicken in particular, suggesting that this product is especially prone to contamination from food handlers. In conclusion it is suggested that local government and relevant authorities provide the vendors with proper resources such as potable water near the vending site as well as adequate physical structures. Education and training initiatives together with regular monitoring by Environmental Health Practitioners should contribute to a safer and more wholesome product to the consumer and ultimately support the growth of the informal vending enterprise as a whole.

OPSOMMING

Die doel van hierdie studie was om die indikator-organismes en patogene op bees- en hoendervleis, sous, hande en voorbereidingsoppervlaktes onder straatvoedsel smouse in Bloemfontein, Suid Afrika te ondersoek. Verder is die bakterie-tellings vergelyk met nasionale riglyne en infektiewe dosisse. Laastens is die kennis en praktyke van die voedselhanteerders tesame met 'n evaluering van die interverwantskappe tussen die organismes onderling, asook tussen geselekteerde organismes en spesifieke praktyke ondersoek. Tellings vir Totale Aërobe, Kolivorme, *Escherichia coli*, *Staphylococcus aureus*, vermoedelike *Salmonella* spp., *Listeria monocytogenes*, giste en skimmels was deurgaans relatief laag en sonder uitsondering binne die infektiewe dosis limiete, hoewel enkeles die nasionale riglyne oorskry het.

Ten einde die respondente se kennis aangaande voedselveiligheidspraktyke te toets, is 'n gestruktureerde vraelys gebruik tesame met 'n oorsiglys. Berging het geblyk 'n probleem te wees omdat geen respondente in besit is van yskaste nie. 'n Bykomende observasie was dat voedselhanteerders geen formele kennis van aanvaarbare voedselhigiëne praktyke het nie. 'n Tekort aan basiese infrastruktuur om praktyke soos sanitasie en opwas te ondersteun het voorgekom. Ondersoeke na die interverwantskappe tussen die organismes onderling, asook tussen geselekteerde organismes en spesifieke praktyke het getoon dat 'n duidelike skakel bestaan tussen indikator-organismes wat normaalweg as indikatore vir hygiene in die formele sektor gebruik word. Verder het dit geblyk dat daar veral in die geval van hoender sterk verwantskappe tussen hanteerder praktyke en mikrobiese voorkoms

bestaan. Ten slotte word voorgestel dat plaaslike regering en die betrokke owerhede toesien dat straatvoedsel smouse toegerus word met die nodige infrastruktuur, onder meer lopende water en fisiese strukture. Voorligtings-inisiatiewe tesame met gereelde monitering deur Omgewingsgesondheids-praktisyns behoort mee te werk om 'n veilige produk aan die verbruiker daar te stel en die straatvoedselbedryf in die geheel te ondersteun.

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CHAPTER 1

INTRODUCTION

1.1 BACKDROP TO THE SOUTH AFRICAN STREET FOOD VENDING SITUATION

In any country, the economic situation, socio-economic changes, population growth and urbanisation are factors promoting the growth of the informal sector of the economy, which includes street food vending undertakings (World Health Organisation (WHO), 1996). These factors are expected to continue playing a part well into the future, and the street food vending business, which is largely but not exclusively an urban phenomenon, will expand accordingly (WHO, 1996; Hanashiro, Morita, Mattè and Mattè, 2004). Street foods are consumed by an estimated 2.5 billion people world wide (Food and Agriculture Organisation (FAO), 2001) and in 1996 it was estimated that private households in South Africa spent R4399,4 million on food bought for eating away from home (from street vendors, restaurants and shops).

In South Africa, as in many developing countries, a faster pace of life and the migration of people from rural to urban areas as a result of unemployment are making street foods an increasingly important part of the daily diet (WHO, 1996; FAO, 2001; Hanashiro *et al.*, 2004). In spite of growing numbers of restaurants, franchises and supermarkets, the number of street vendors continues to increase. It is clear, therefore, that the sale of street foods is very much part of the rapidly growing business sector. Perhaps the greatest advantage of these street-vended foods is that they provide a source of inexpensive, convenient and often nutritious food for millions of men, women and students living in the rural and urban areas near their places of work or study (FAO, 1997; Tinker, 1997; Azanza, Gatchalian and Ortega, 2000).

Street food vending is a source of income for an enormous number of people, particularly women, providing an opportunity for self-employment and the chance to develop business skills with low capital investment (Canet and N'Diaye, 1996; WHO, 1996; Tinker, 1997). Women have been playing a role in street food vending for many years and they are often the owners or employees of the street food businesses. In certain areas they represent seventy to ninety percent of the vendors, although in some countries they may be behind the scenes preparing food, rather than selling it (FAO, 1997; Kapila, 1997; Pick, Ross and Dada, 2002). The number of employment opportunities generated in the informal sectors of South Africa was estimated to be 911 000, which exceeds the 40 200 generated in the formal sector (Chakravarty, 2001). Street food vending businesses are extremely important in alleviating poverty, which is the major cause of food insecurity (Codjia, 2000). Furthermore, such undertakings assist in curbing the high unemployment rate for many people and also provide the public with culturally acceptable food.

1.2 DEFINITION OF STREET FOODS

The term 'street foods' refers to food and beverages prepared and/or sold by vendors in streets and other public places for immediate consumption or consumption at a later time without further processing or preparation. The final preparation of street foods occurs when the customer orders the meal, which can be consumed where it is purchased or taken away and eaten elsewhere (WHO, 1996; Kubheka, Mosupye and von Holy, 2000; Kidiku, 2001; Mensah, Yeboah-Manu, Owusu-Darko and Ablordey, 2002). Street vendors are a source of convenient and affordable foods which may be consumed by

anyone including those whose means may be meagre (WHO, 1996; Carolissen-Mackey, 1998). Street foods are an indispensable part of both the urban and the rural diet in the developing world, and they contribute towards the meeting of adequate nutritional requirements (Winarno and Allain, 1991; Chauliac and Gerbouin-Rerolle, 1996). Vending stalls are usually located outdoors or under a roof, and are usually accessible from the street. These vendors are usually situated where there is heavy movement of people, for example at taxi ranks, bus stations, train stations, building construction sites, schools and hospitals, since their marketing success depends exclusively on location and word-of-mouth promotion (Winarno and Allain, 1991). Street foods reflect traditional cultures based on local products, as well as new dishes adapted to urban living conditions and the low incomes of many city dwellers. The vendors sell a wide variety of foods with differing preparation methods (Canet and N'Diaye, 1996). In South Africa, typical street food vendors sell dishes consisting of maize porridge served with either chicken or beef pieces or stew, tomato and onion gravy or salad (Kubheka *et al.*, 2001) (Figure 1.1).

Street food undertakings are usually operated by families, although benefits resulting from the sale of food filter through the entire local economy. Vendors buy their food from local supermarkets, grocery stores and butcheries, thus linking their enterprises directly with those of suppliers (Winarno and Allain, 1991).

Figure 1.1: Typical food sold by South African street food vendors

1.3 COMMON TRIALS AND TRIBULATIONS FACING STREET FOOD VENDORS

In spite of the potential benefits provided by street food vendors, there are also a variety of associated problems. The conditions under which street vendors operate are usually unsuitable for the preparation and selling of food (Ekanem, 1998; Mosupye and Von Holy, 1999). Many vendors work in outside areas with no physical structures, outside of approved sales areas, on pavements and in inhospitable surroundings (Gnammon-Adiko, 1996) (Figure 1.2). In most cases, at the vending sites they lack basic infrastructure and services such as potable running water. Therefore, hand and dishwashing water is usually insufficient and often reused, sometimes without soap (Abdussalam and Kaferstein, 1993) (Figure 1.3). The vending stalls or carts used are often crudely constructed or corrugated iron or plastic structures (Figures 1.4 and 1.5). Waste water and garbage are usually disposed in the vicinity of the stalls, this practice may later attract insects and rodents to the vending site (Figure 1.6) (Mosupye and Von Holy, 2000, Kubheka *et al.*, 2001).

In addition, toilets are not always available nearby, so that vendors, upon returning from the toilets, they either do not wash their hands or they wash their hands in water used for washing dishes (Mosupye and Von Holy, 2000). Foods are sometimes displayed for long periods of time and may not be reheated before they are served (Mensah *et al.*, 2002). Other negative aspects of the street food trade are the hazard of foodborne illnesses

Figure 1.2: Street vendor operating with no form of structure

Figure 1.3: Water used by street food vendors for washing dishes

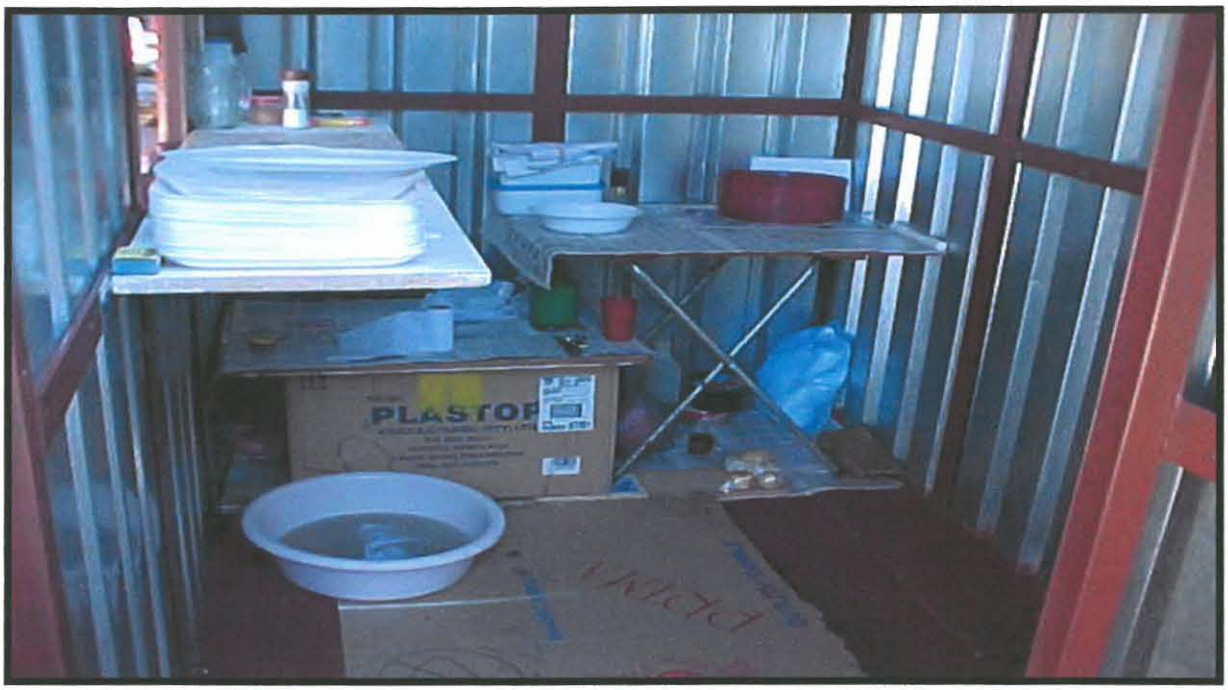

Figure 1.4: Typical vending stall made from corrugated iron

Figure 1.5: Typical vending stall made from plastic material

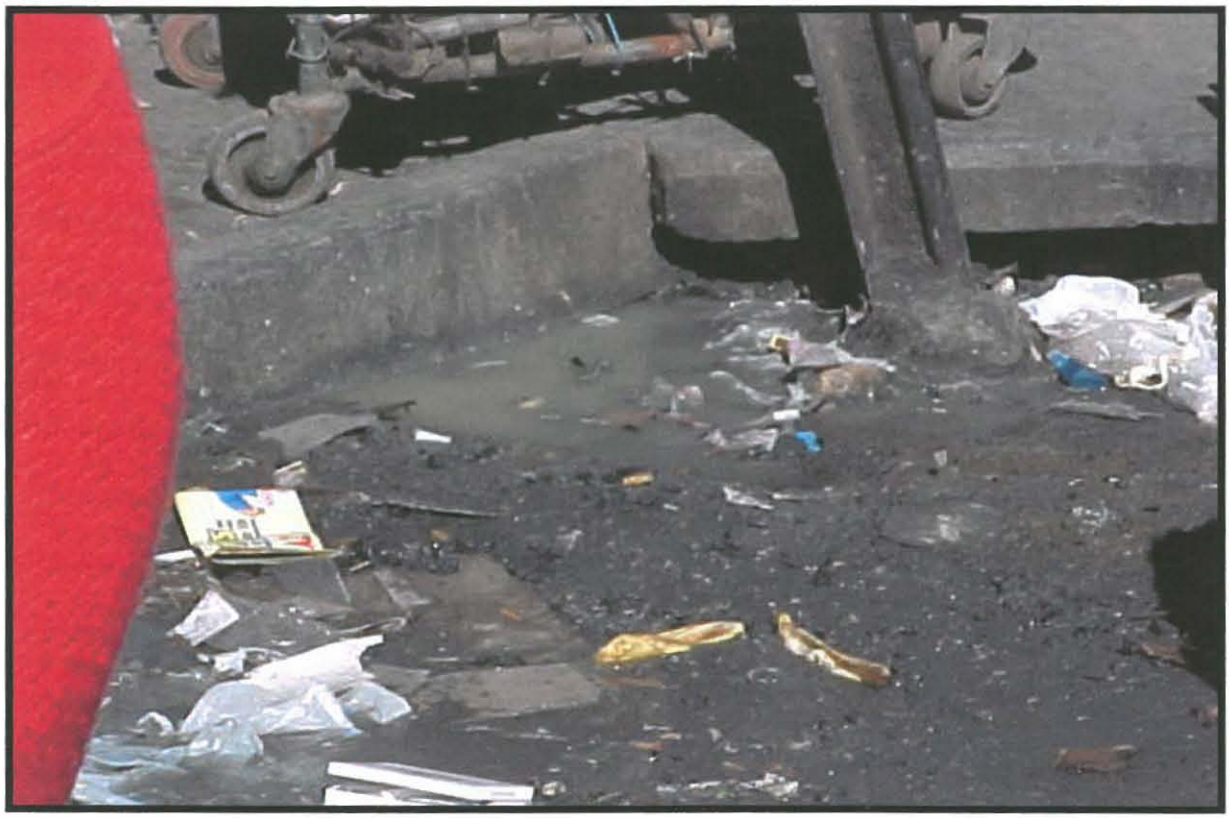

Figure 1.6: Waste water discarded close to food stalls

associated with these foods, the obstruction of pedestrians and traffic caused by vending stalls and vehicles, and also the littering of public spaces (Codjia, 2000). Stalls often lack appropriate facilities such as refrigerators for storing food to prevent contamination or the multiplication of bacteria, especially on cooked foods (Carolissen-Mackay, 1998; Ekanem, 1998; Martinez-Tomè, Vera and Murcia, 2000; Walker, Pritchard and Forsythe, 2003). The risk of contamination and infection arising from poor practices in terms of preparation, storage and selling of food has a bearing on consumer health, morbidity and even mortality, particularly among those individuals with immuno-compromised systems, the very young and the aged. The majority of people involved in these businesses lack sufficient knowledge of basic food safety measures (Codjia, 2000), and municipalities and authorities find it hard to control the large numbers of street food vending operations because of their diversity, mobility and their temporary nature (WHO, 1996).

1.4 FACTORS CONTRIBUTING TO FOODBORNE DISEASE OUTBREAKS IN INFORMAL SETTINGS

There are many potential routes of contamination during the processing of food that could lead to the occurrence of foodborne disease outbreaks, including contamination from human sources, pests or the ingredients (Alcock, 1986; Stretch and Southgate, 1991) (Figure 1.7). Food may also be contaminated by pieces of equipment with which it comes into contact. In the case of street vending, the risk of cross-contamination in the food preparation area is also increased as a result of the problems faced by vendors, as mentioned above. Alcock (1986) points out that raw and ready-to-eat food

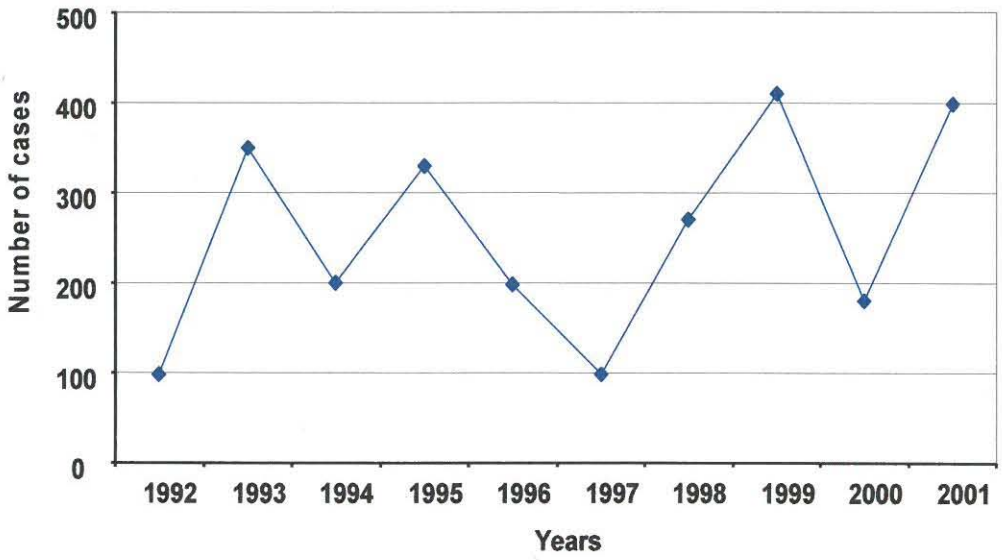

Figure 1.7: Cases of foodborne illness reported in South Africa between 1992 and 2001 (Republic of South Africa, 2002)

should always be kept separate; if not, contamination may take place and contaminants may build up in such numbers that a health hazard results. Figure 1.7 reflects cases of foodborne illness which were reported in South Africa between 1992 and 2001. The highest cases were reported in 1999 (±410).

A common source of such contamination is the cutting of both raw and cooked meat on the same cutting board (Frazier and Westhoff, 1988). The proliferation of organisms in food is also related to storage at improper temperatures: this practice may result in foods becoming hazardous to the consumer (Table 1.1).

It should be assumed that all potential spoilage microorganisms may be found anywhere and that all food is capable of supporting microbial growth. If food is kept long enough under conditions that allow contamination and spoilage to occur, or if food is overly handled during preparation and not refrigerated or inadequately reheated before final consumption, there is a serious risk of foodborne illness occurring (Alcock, 1986;). Handling of cooked food after raw food without washing hands and utensils provides an opportunity for the recontamination of the cooked food. Furthermore, poor hygiene practices of food handlers, such as scratching the hair, not covering infected cuts, not washing hands after using the toilet or after handling contaminated material or pets, and spitting or sneezing over the food, all increase the risk of contamination (Cameron, 1978).

Table 1.1: Factors contributing to general foodborne disease outbreaks and management of street foods (adopted from WHO (1996) and Panisello, Rooney, Quantick and Stanwell-Smith (2002)

Temperature misuse	**%**
Improper heating	40
Improper reheating	3
Food left at room temperature	82
Preparation too far in advance	73
Contamination by pathogens	
Contamination of raw food	76
Cross-contamination	73
Contaminated water	57
Inadequate cleaning of equipment	72
Infected food handler	70
Inadequate environment	
Insufficient hygiene	3
Inadequate facilities	1
Management of street foods	
Registration of street vendors required	32
Code of practice applied	32
Periodic medical examination required	41
Periodic training required	34

According to the WHO (1996), microbiologically contaminated food is responsible for a high proportion of diarrhoeal and other infectious diseases. Foodborne diseases are amongst the most widespread of health problems in both the developed and the underdeveloped areas, with food being a major route for transmission (Republic of South Africa, 1999).

1.5 FINDINGS OF THE WORLD HEALTH ORGANISATION SURVEY ON STREET-VENDED FOODS

A survey was conducted in 1993 by the WHO to assess the situation in regard to street food vending and to obtain the views of responsible authorities concerning the hazards posed by food prepared and sold on the streets, and to suggest approaches needed for managing these hazards. Over 100 countries including South Africa participated in this survey. The survey noted that in almost all countries reported to be serving a wide variety of foods, the methods of food preparation and the facilities and infrastructure did not differ significantly.

Key findings of the WHO survey of street-vended foods:

- street-vended foods included diverse foods such as meat, fish, fruits, vegetables, grains, frozen produce and beverages;
- methods of preparation included foods served without any preparation, ready-to-eat foods and foods cooked on site by the vendors;
- the structure of the vending facilities varied from mobile carts to fixed stalls and food centres;

- infrastructure was poorly developed with restricted access to potable water, toilets, refrigeration and washing and waste disposal facilities;
- the majority of countries reported contamination of food (from raw food, infected food handlers and inadequately cleaned equipment) and time and temperature abuse were the major factors contributing to foodborne disease; and
- most countries reported insufficient inspection personnel, insufficient application of the HACCP concept and noted that registration, training and medical examinations were not amongst management strategies carried out.

1.6 RATIONALE

In spite of the mentioned trials and tribulations facing street vendors, as well as the obvious opportunities for microbial contamination, Mosupye and von Holy (1999) as well as van der Merwe and Anelich (2004) concluded that studies done amongst street vendors in Gauteng (S.A) have shown that food served by the vendors are actually of much better quality and safety than perceived. However, with the increased population growth, urbanisation, unemployment and political instability in Africa, the sale of foods on streets is increasing and the question arises whether the quality and safety of street foods will decline concomitant to the increased demand. Considering the fact that communities occasionally protest against poor service delivery by municipalities, dumping of waste on the street near or in the vicinity of street vending stalls often takes place and may later attract pests to the vending site.

Safer methods of preparation might be further compromised due to insufficient space and time as well as competition which may cause the vendors to become ignorant towards food safety. It is furthermore unfortunately true that foods in general serve as an ideal vehicle for transporting microorganisms. If microorganisms are pathogenic, their association with the food supply is critical from a public point of view (Codjia, 2000). According to the WHO (1996), microbiologically contaminated food is responsible for a high proportion of diarrhoeal and other infectious diseases, especiallly in developing countries where 70% of the diarrhoeal diseases among infants are now believed to be due to the ingestion of contaminated food and water (Barnes and Abdussalam, 1990; Carolissen-Mackay, 1998). Although, informal markets will continue to grow they should, however, be controlled to ensure the safety of all consumers. Thus, it is up to the vendors to use proper precautionary measures to prevent unwanted bacteria from entering food. Apart from posing a health risk, foodborne diseases are responsible for taking up a huge portion of the health budget due to the fact that the medical personnel have to provide an all year round twenty-four-hour service. Therefore, health education regarding personal hygiene, food hygiene, environmental hygiene, as well as the strict enforcement of health regulations, is the best tool for the promotion of public hygiene and will ensure the production of safe and nutritious food by the street vendors (Parker, 1993). Proper hygiene prevents food poisoning and it makes good business sense to sell healthy, uncontaminated food to customers: in this way the reputations of the vendors will also be protected.

The aims of the study were therefore:

- to quantify the indicator organisms and pathogens detected on beef, chicken and gravy samples and on the hands and food preparation surfaces of street food vendors in the city of Bloemfontein (S.A);
- to compare the bacterial counts detected on the samples with the national guidelines as well as with the infective dose limit as proposed by literature and the National Department of Health (2000) S.A;
- to assess food handlers' knowledge regarding the safety of food as well as their practices and
- to conclude on possible relationship between specific practices and the resulting microbiota.

Such information could contribute towards the making of further recommendations to add to the existing information from studies conducted elsewhere.

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CHAPTER 2

THE PREVALENCE OF BACTERIA ON FOOD, HANDS AND PREPARATION SURFACES OF STREET VENDORS IN THE CITY OF BLOEMFONTEIN, SOUTH AFRICA.

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2.1 ABSTRACT

Samples of beef, chicken and gravy, as well as samples from hands and preparation surfaces were collected over a period of four months, from various food vendors in the city of Bloemfontein, South Africa. The samples were analysed for the presence of total viable counts (TVC), Coliforms, *Escherichia coli*, *Staphylococcus aureus*, presumptive *Salmonella*, *Listeria monocytogenes*, yeasts and moulds. Respective mean TVC were 1.2×10^4 cfu.g^{-1} and 1.6×10^4 cfu.g^{-1} respectively for beef and chicken and 3.8×10^3 cfu.g^{-1} for gravy samples. Coliforms, *E. coli and Staphylococcus aureus* counts were lower than the total viable counts. Presumptive *Salmonella* counts were 1.1×10^1 cfu.g^{-1} on beef, 2.7×10^2 cfu.g^{-1} on chicken and 6.0×10^1 cfu.g^{-1} in gravy samples. *Listeria monocytogenes* was not detected in any of the food or gravy samples. Yeasts counts detected on beef were 5.8×10^1 cfu.g^{-1}, with none on chicken samples and 3.2×10^2 cfu.g^{-1} in gravy, while mould counts were 1.4×10^1 cfu.g^{-1} on beef, absent in chicken, and 6.4×10^1 cfu.g^{-1} in gravy. Microbial loads on preparation surfaces were relatively low throughout, and counts from the food were without exception inside the infective dose limit, although some exceeded the national guidelines.

Key words: street food, hygiene, safety

2.2 INTRODUCTION

According to the World Health Organisation (1996) microbiologically contaminated food is responsible for a high proportion of diarrhoeal and other infectious diseases. Every year thousands of people suffer from food poisoning as a result of consuming food that may look, taste and smell perfectly normal but is in fact contaminated with large numbers of pathogenic bacteria. Clayton *et al.* (2002) state that contaminating microbiota in particular result from improper food handling practices, and studies have shown that infected food handlers play a role in food contamination (Dalton *et al.*, 1996; Angelillo, 2001). Improper practices on the part of food handlers contribute to approximately 97% of foodborne illnesses in food service establishments (Howes *et al.*, 1996). Leading causes of foodborne illnesses are poor personal hygiene and cross-contamination, the latter being defined as the transfer of bacteria from a contaminated source to uncontaminated food via a non-food vehicle.

Foodborne diseases have in recent times escalated and intensified because foodborne pathogens are becoming increasingly virulent due to increased resistance to antimicrobial agents (Desmarchelier *et al.*, 1994; Department of Health, 2000; Tessi *et al.*, 2002). Thus, food that is otherwise wholesome and of acceptable quality may be rendered unsafe as a result of cross-contamination (Alcock, 1986; Hobbs and Roberts, 1993; Hemminger, 2000). For example, an employee's hands might become contaminated when he/she uses the toilet, or bacteria might be spread from raw meat to working surfaces

or to cooked foods by the hands of the food handlers, and in this way poor practice may increase the risk of food contamination.

In South Africa, with the increased population growth and migration to cities, the sale of "street foods" is on the increase (Carolissen-Mackay, 1998; Food and Agriculture Organization, 2001) and, amidst the increasing number of restaurants, franchises and supermarkets, the street vendors have prevailed. The WHO (1997) stated that a major advantage of street-vended foods is that they provide a source of inexpensive, convenient and nutritious food to people living in urban, peri-urban and rural areas (Mosupye and von Holy, 1999; Kubheka *et al.*, 2001). Mensah *et al.* (2002) and the WHO (1996) describe 'street-vended foods' as a variety of foods and beverages prepared and/or sold on the streets and other public places for immediate consumption or consumption at a later time without further processing or preparation. The final preparation occurs when the customer orders and consumes the food at or in close proximity to the point of sale. The consumption of street food is common in many countries where unemployment is high, salaries are low, and work opportunities limited. The street food vending businesses are often lucrative because they benefit from a positive cash flow, tax free earnings, and can determine their own working hours (Toh and Birchenough, 2000).

In contrast to the potential benefits they provide, the hygiene aspects of vending operations are a major source of concern (Mosupye and von Holy, 2000; Bryan *et al.*, 1992). Vendors are often poor, uneducated and lack understanding about proper food safety and hygiene measures, and toilets

and adequate washing facilities are not always available. Hands, utensils and dishes are often washed in one bucket, while foods served are usually not effectively protected from dust and flies and may harbour foodborne pathogens (Abdussalam and Käferstein, 1993; Mensah *et al.*, 2002). An additional problem is that foods are inadequately reheated, inadequately refrigerated and usually prepared several hours before being served which may result in the proliferation of microorganisms (Bryan *et al.*, 1988; Abdussalam and Käferstein, 1993; Moy *et al.*, 1997; Martínez-Tomè *et al.*, 2000; Mensah *et al.*, 2002).

Because of the unhygienic conditions under which street food vendors in South Africa operate and the inadequate infrastructure within which they work, it was deemed necessary to quantify the indicator organisms and pathogens detected on beef, chicken and gravy samples and on the hands and food preparation surfaces of street food vendors in Bloemfontein. Such information could contribute towards the making of further recommendations to add to the existing information in studies conducted in the Gauteng area by Mosupye and von Holy (2000). The study further compared the bacterial counts detected on the samples to the national guidelines as well as to the infective dose limit as proposed in literature and by the Department of Health (2000). Finally, suggestions are made with regard to control measures that may be applied to minimise food contamination to an appropriate level.

2.3 MATERIALS AND METHODS

2.3.1 Sampling protocol

Food samples and bacterial samples from hands and preparation surfaces were collected from 45 randomly selected vendors located in the Central Business District as well as in selected townships in the city of Bloemfontein, Free State Province, South Africa over a period of four months. Beef, chicken and gravy samples (50g each) were collected between 10:00 and 14:00 from each vendor during the holding period of the food and transferred to sterile Whirl Pak bags (Nasco, USA). Samples were collected from the thumbs and three middle fingers of both hands as well as from the centre and the sides of the food preparation surfaces. 55mm Rodac surface contact plates were used (Rodac Nunc, Denmark) for this purpose. The samples were kept on ice during transportation to the laboratory and analysed without delay (Bryan *et al.*, 1997).

2.3.2 Microbiological analysis

From the 50 gram food sample 10 grams were weighed off and aseptically homogenised in 90 ml sterile peptone water (Biolab, Midrand, SA) using a Stomacher (Seward Stomacher 400) for 2 minutes (Mosupye and von Holy, 1999; Nortjé *et al.*, 1999; Kubheka *et al.*, 2001; Fang *et al.*, 2002). Serial dilutions were prepared and 0.1 ml aliquots plated onto media using the spread plate method with plates incubated under aerobic conditions (Herbert, 1990; Martinez-Tomè, 2000). For the purpose of this study all analyses were done in duplicate.

Total Viable Counts

For the enumeration of Total Viable Counts (TVC), Plate Count Agar (PCA) plates (Merck-SA) were incubated at 25ºC for 48 hours (Houghtby *et al.*, 1993; Vorster *et al.*, 1994).

Escherichia coli and Coliforms

Violet-Red-Bile-MUG agar plates (Biolab, RSA) were used for quantification of *E. coli* and Coliforms and plates were incubated at 37ºC for 18-24 hours (Scharlau, 2000). Typical *E. coli* colonies were dark red with a diameter of 2 to 5 mm. Coliforms appeared as small pink colonies. *E. coli* (ATCC 25922) was used as positive control and a blank VRBM agar plate as negative control, incubated at the appropriate temperatures.

Staphylococcus aureus

Baird-Parker Agar (Biolab, RSA) with 50 ml egg-yolk tellurite emulsion (Merck, RSA) was used and the plates were incubated at 35ºC for 48 hours (Fang *et al.*, 2002). Typical *S. aureus* colonies were black with white margins surrounded by clear zones. For positive control *S. aureus* (ATCC 25923) was used and a blank Baird-Parker Agar plate was used as negative control and incubated at 35ºC for 48 hours.

Presumptive *Salmonella*

Pre-enrichment was done in Buffered Peptone Water for the enrichment of *Salmonella* spp. (Biolab, RSA) at 35ºC for 16-20 hours, after which an aliquot was transferred to Brilliant Green Agar and incubated at 42ºC for 24-48 hours

(Van Schothorst and Renaud, 1983). *Salmonella enteritidis* (ATCC 13076) was used as positive control and a blank BGA plate was used as negative control.

Listeria monocytogenes

A ten gram sample was transferred to a sterile Stomacher bag, diluted with 90ml enrichment broth (LEB) (Merck) and homogenised for 2 minutes with a Stomacher (Seward Stomacher 400). After enrichment at 30°C for 48 hours, 0.1 ml of the homogenate was streaked onto Listeria Selective Agar (LSA). Plates were incubated at 30°C for 48 hours (Curtis and Lee, 1995). Listeria Selective Agar plates were incubated at 37°C for 48 hours. *L. monocytogenes* (ATCC 19117) was used for confirming the appearance of *Listeria monocytogenes* on Listeria Selective Agar and for negative control blank LSA plates were used. *Listeria monocytogenes* colonies were 2mm in diameter and appeared as green-grey coloured colonies with a black core and halo (Scharlau, 2000).

Yeasts and Moulds

Potato Dextrose Agar acidified with tartaric acid (pH 3.5) (PDA, Merck-SA) was used for the enumeration of total fungi and incubated at 25°C for 48 hours. Mould growth was recognised by its mycelial appearance (Frazier and Westhoff, 1988).

2.4 RESULTS AND DISCUSSION

Total viable counts

Total Viable Counts are used to determine the general degree of contamination on a particular foodstuff (Aberle *et al., 2001*). Figure 2.1 (A, B and C) represents amongst others, total viable counts ranging from 10^3 to 10^4 cfu.g^{-1} on beef and chicken samples and counts ranging from 10^2 to 10^3 cfu.g^{-1} in gravy samples. The Total Viable Counts observed in the present study were lower than those reported by Bryan *et al.* (1997) for cooked meat and chicken samples (>10^5 cfu.g^{-1}). The national standard for total viable counts on working surfaces is 100 CFU.cm^2 and all samples conformed to this guideline (Table 2.1).

Coliforms

Coliform counts are those members of the enterobacteriaceae which ferment lactose and produce gas. They are applied to assess the adequacy of sanitation, processing and/or post-processing recontamination due to cross-contamination by raw materials, dirty equipment or improper hygienic handling and indicate the possibility of faecal contamination (Buchanan, 2000; Department of Health, 2000). Coliforms are furthermore used to assess microbial proliferation in foods which may result from the prolonged holding of food at ambient temperatures (Department of Health, 2000). Figure 2.1 (A, B and C) represents the coliform counts ranging from undetectable to 10^3 cfu.g^{-1} in all food samples. Of all samples collected, 74% of the beef samples, 72% of the chicken samples and 73% of the gravy samples were contaminated with coliforms. Ekanem (1998) reported similar results of coliforms counts ranging

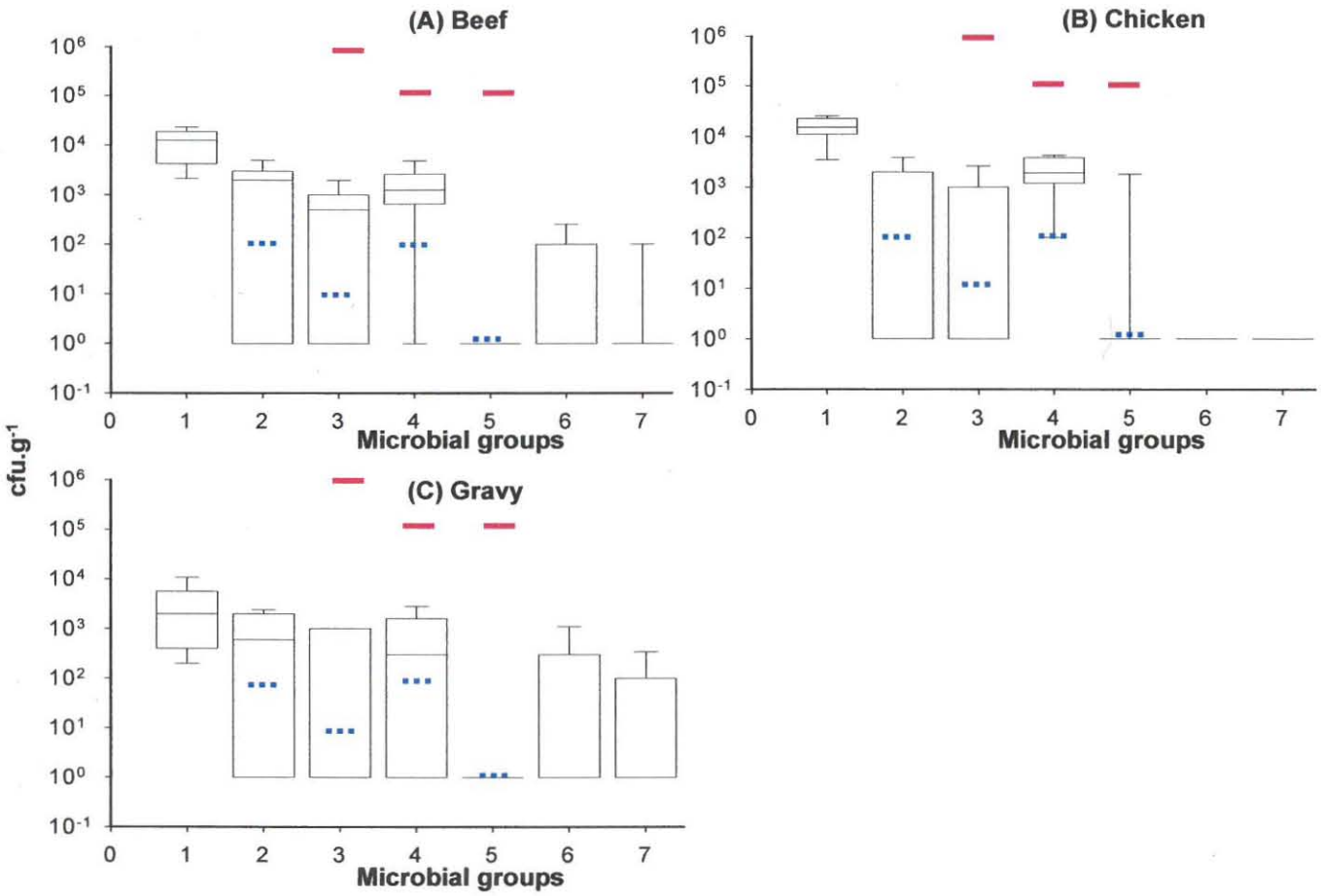

Figure 2.1: Bacterial counts detected on food sold by street vendors in the city of Bloemfontein. 1 – Total Viable Counts, 2 – Coliforms, 3 – *Escherichia coli,* 4 – *Staphylococcus aureus*, 5 – Presumptive *Salmonella,* 6 – Yeasts and 7 – Moulds. (▪▪▪) Guideline limit (—) Infective dose limit

Table 2.1: The percentage occurrence of bacteria on hands and food preparation surfaces of food vending stalls in Bloemfontein

Surfaces	Coliforms (%)	[a]*E. coli* (%)	[b]*S. aureus* (%)	*Salmonella* (%)	Yeasts (%)	Moulds (%)
Thumb [c](L)	20	0	58	0	27	7
Thumb [d](R)	29	2	60	0	31	9
Three middle fingers (L)	20	4	69	2	24	0
Three middle fingers (R)	38	31	69	4	34	0
[e]C/table	56	16	43	16	44	9
[f]S/table	24	2	4	0	2	0

[a] *E. coli* - *Escherichia coli*

[b] *S. aureus* - *Staphylococcus aureus*

[c](L) – left hand

[d](R) – right hand

[e]C/table – centre of the table (food preparation surface)

[f]S/table – side of the table (food preparation surface)

between 10^2 and 10^3 cfu.g^{-1} in meat products sold on the streets of Nigeria. Table 2.1 represents amongst others the presence of coliforms isolated on hands of food handlers and on food preparation surfaces where 20% of the left thumbs and 29% of the right thumbs of the food handlers showed coliform presence. Coliform organisms were furthermore detected on 20% of the three middle fingers of the left and 38% of the three middle fingers of the right hands. At the centre of the food preparation surfaces coliforms were detected in 56% of cases, with 24% at the sides.

Escherichia coli

Escherichia coli is a normal inhabitant of the intestinal tract of humans and warm-blooded animals and is generally regarded as an indicator of pathogenic microbiota originating from faecal contamination and poor sanitation during food processing (Stretch and Southgate, 1991; Eisel *et al.*, 1997). In this study, *E. coli* counts ranging from negligible to 10^3 cfu.g^{-1} were detected (Figure 2.1: A, B and C), in 50% of beef samples, 55% of chicken samples and 49% of gravy samples. None of the food samples analysed exceeded the infective dose limit. Keeping in mind that the samples were collected during the holding period and had thus already been exposed to high temperature processing, counts of *Escherichia coli* could only be due to exposure of foods to faecal contaminants from the hands of food handlers, and from contaminated working surfaces and utensils. Therefore it is of the utmost importance to pay attention to proper personal hygiene, particularly with regard to hand-washing after visiting the toilet to prevent contamination. *E. coli* was not detected on the thumb prints of the left hand, but 2% of the

right thumb prints, 4% of the three middle fingers of the left hand and 31% of the three middle fingers of the right hand were contaminated. *E. coli* were furthermore isolated from 16% of the centre of table surfaces and 2% of the table sides (Table 2.1).

Staphylococcus aureus

Figure 2.1 (A) shows *Staphylococcus aureus* counts ranging between 10^2 and 10^3 cfu.g^{-1} on beef samples, with counts *circa* 10^3 cfu.g^{-1} on chicken and between undetectable and 10^3 cfu.g^{-1} in gravy. *S. aureus* was detected in 68% of beef samples, 91% of chicken and 71% of gravy.

S. aureus organisms are likely to have been introduced into the food during cutting, chopping and mixing, and also after cooking by means of cross-contamination, for example from utensils used by vendors to serve food. Holding food at ambient temperatures could have further contributed to the prevalence of the organism in the food. From observation of preparation practices, it was clear that knives were used without being sanitised and were used for cutting and chopping raw vegetables. Mosupye and Von Holy (1999) reported similar results for ready-to-eat street-vended foods. However, in terms of *S. aureus* the food samples analysed in this study shows that consumers were at relatively low risk of contracting foodborne illnesses, the *S. aureus* counts detected being below the infective dose limit of 10^5 cfu.g^{-1} (Department of Health, 2000). Furthermore, *S. aureus* counts detected in this study were relatively low compared to similar studies done elsewhere: for example, *S. aureus* counts detected in Pakistani street-vended foods were

often found to exceed 10^5 cfu.g^{-1} (Bryan *et al.*, 1992). Table 2.1 further illustrates the distribution of *S. aureus* on 58% of the left thumb prints and in 60% of the right thumb prints. Similar results (69%) were noted on the three middle fingers of both the left and right hands of food handlers. *S. aureus* counts were present in 43% of samples from tables at the centre and in 4% of the tables at the side.

Presumptive *Salmonella* spp. and *Listeria monocytogenes*

Figure 2.1 (A and C) represents presumptive *Salmonella* spp. detected in counts ranging from undetectable to 10^2 cfu.g^{-1} on beef and gravy samples and counts ranging from undetectable to 10^3 cfu.g^{-1} in chicken Figure 2.1 (B). Presumptive *Salmonella* counts were detected in 6% of the beef samples, 18% of the chicken samples and 7% of the gravy samples. In general, the presence of *Salmonella* spp. in cooked foods may be due to inadequate sanitation, poor personal hygiene and inadequate refrigeration. Proliferation of this microorganism in foods may furthermore result from post-cooking handling by workers who are carriers of the organism (Department of Health, 2000). Presumptive *Salmonella* spp. was detected on 2% of the three middle fingers of the left hands and in 4% of the three middle fingers of the right hands of food handlers, and was isolated on 16% of the tables at the centre (Table 2.1). The presence of presumptive *Salmonella* spp. on hands and on food preparation surfaces is likely to have resulted from handling and preparing contaminated raw foods (Hobbs and Roberts, 1993). *Listeria monocytogenes* was not detected in any food or surface samples.

Yeasts and Moulds

Yeasts and moulds do not usually cause food poisoning, although some types can cause food spoilage and illness due to the production of mycotoxins (Stretch and Southgate, 1991). Together with the total viable counts the yeasts and moulds however, give a holistic view of the general microbiological contamination of food products. In addition, where food is prepared, displayed and sold in the open air, fungi indicates the degree of environmental contamination to which the product is exposed. Figure 2.1 (A, B and C) shows yeast counts ranging from undetectable to 10^2 cfu.g^{-1} on beef samples, while yeasts were absent from all chicken samples. Yeasts were detected in counts ranging from undetectable to 10^3 cfu.g^{-1} in gravy samples. Figure 2.1 (A, B and C) shows mould counts ranging from undetectable to 10^2 cfu.g^{-1} in beef and gravy samples whilst being absent from all chicken samples. Yeast counts were detected in 27% of samples from the left thumb prints, in 31% of the right thumb prints, 24% of the three middle fingers of the left hand and 34% of the three middle fingers of right hand. Food preparation surfaces showed yeast counts in 44% of samples from tables at the centre and in 2% from the side of the tables. Mould counts were detected on 7% of the left thumbs and on 9% of the right thumbs of food handlers, as well as on 9% of the tables at the centre.

Compliance with proposed guidelines and safety indicators

A summary of the average counts of the microorganisms compared with the proposed maximum limits and infectious doses is presented in Table 2.2. The Department of Health (2000) has proposed a maximum limit of 100 cfu.g^{-1} for

Table 2.2: A summary of the level of compliance of different microorganisms in cooked food to proposed guidelines and limits

Organisms	Department of Health, National Guideline ($cfu.g^{-1}$)	Infective guideline ($cfu.g^{-1}$)	Percentage samples not complying to guideline limit	Percentage samples not complying to infective dose limit
Beef				
Coliforms	100	Unknown	74	-
E. coli	10	10^6	50	0
S. aureus	100	10^5	68	0
Salmonella spp.	0 $cfu.25g^{-1}$	10^5	6	0
L. monocytogenes	100	Unknown	0	-
Chicken				
Coliforms	100	Unknown	72	-
E. coli	10	10^6	55	0
S. aureus	100	10^5	91	0
Salmonella spp.	0 $cfu.25g^{-1}$	10^5	18	0
L. monocytogenes	100	Unknown	0	-
Gravy				
Coliforms	100	Unknown	74	-
E. coli	10	10^6	49	0
S. aureus	100	10^5	71	0
Salmonella spp.	0 $cfu.25g^{-1}$	10^5	7	0
L. monocytogenes	100	Unknown	0	-

Coliforms in cooked foods. Coliforms that did not comply with the guideline were found in 74% (n = 25/34) of beef samples, 72% (n= 8/11) of chicken samples and 74% (n = 33/45) of gravy samples. To date an infective dose for Coliforms has not been indicated in literature. The mean *E. coli* count was 6.2 x 10^2 cfu.g^{-1} for beef samples, 7.3 x 10^2 cfu.g^{-1} for chicken, and 3.5 x 10^2 cfu.g^{-1} for gravy samples, thus 50% (n = 17/34) of beef, 55% (n = 6/11) of chicken and 49% (n= 22/45) of gravy samples did not comply with the maximum limit of 10 cfu.g^{-1} proposed by the South African Department of Health (2000). Literature reports an infective dose of 10^6 cfu.g^{-1} for *E. coli* (Department of Health, 2000). Hence, all samples of beef, chicken and gravy were below the infective dose limit, which indicates that the food consumed is not likely to result in any illnesses. A maximum limit of 100 cfu.g^{-1} for *S. aureus* has been established by the South African Department of Health (2000) for cooked foods. Throughout this study, the mean *S. aureus* counts were 2.4 x 10^3 cfu.g^{-1} for beef samples, 2.1 x 10^3 for chicken samples and 9.3 x 10^2 for gravy samples. A total of 68% (n = 23/34) of beef, 91% (n = 10/11) of chicken and 71% (n = 32/45) of gravy samples did not comply with the guideline, although all beef, chicken and gravy samples were below the proposed infective dose of 10^5 cfu.g^{-1} (Department of Health, 2000). Presumptive *Salmonella* spp. was detected in 6% (n = 2/34) of beef, 18% (n = 2/11) of chicken and 7% (n = 3/45) of gravy samples and all these samples although all of the samples were within the infective dose limit of 10^5 cfu.g^{-1}. The South African Department of Health has established a guideline of 100 cfu.g^{-1} for *L. monocytogenes* although Forsythe (2000) reports that an infective dose limit is still unknown. All beef, chicken and gravy samples complied with the set

L. monocytogenes guideline as well as with the infective dose limit. Guidelines have not yet been established for yeasts and moulds, although the National Department of Health (2000) states that people should not consume foods that are visibly mouldy. Not complying with the National Standard does not necessarily indicate the presence of pathogens in food, but rather presents a measure of the general hygiene.

2.5 CONCLUSION

In general the microbiological quality of the foods served by the street vendors in the study area was within acceptable safety limits. The presence of selected microorganisms in foods and on surfaces, though detected in low numbers, indicated that there is a need for improving infrastructure, such as providing proper sanitation facilities. Soriano *et al.* (2002) indicate that proper changes to the infrastructure would improve the microbial quality of the meals served. Vendors should be made aware of the hazards they may pose to consumers if improper preparation practices are followed. They should furthermore be made aware of the need for practising proper personal hygiene, the role of cooking food properly and the benefits of storage of food at low temperatures. Safe food production is based on the implementation and application of general preventative measures such as Good Hygiene Practices (GHP) and Good Manufacturing Practices (GMP) (Soriano *et al.*, 2002; Reij and Aantrekker 2004). Wilcock *et al.* (2004) add that quality control is also one of the essential strategies in the food industry. For foodborne illnesses to be reduced it is crucial to gain an understanding of the interaction of prevailing food safety beliefs, knowledge and practices of food handlers.

Even though the bacterial loads detected on the foods and preparation surfaces in this study were below the set guideline limits, it is still required that the local government intervene to ensure that the standard of safety of street foods is the best attainable under the circumstances of the prevailing local situation. This could be accomplished by the researcher of the present study, local government and relevant authorities playing a role in providing the vendors with training and seminars on food safety. Such training should preferably be made available to the street food vendors free of charge or at an affordable rate. This would contribute as community engagement and would demonstrate the benefits of research to the vendors. When this is done, the vendors would be more willing to cooperate/participate in future research.

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CHAPTER 3

KNOWLEDGE AND PRACTICES REGARDING FOOD SAFETY AMONGST STREET VENDORS IN THE CITY OF BLOEMFONTEIN, SOUTH AFRICA.

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3.1 ABSTRACT

A structured questionnaire and a checklist were used in the interviewing of street food vendors on aspects relating to food safety knowledge and practices, in the city of Bloemfontein, South Africa. Questions were grouped into five categories as follows: a) demographic data; b) cooking and preparation practices; c) personal hygiene practices and health; d) storage practices; and e) sources and suppliers of food. During the period of study it was clearly observed that there was a good chance of food being contaminated as a result of using one utensil (without washing it between preparation of items) for stirring different foodstuffs. A few vendors reported that they prepared food even when they were ill: this practice could result in the spread of bacteria from the food handler's hands to food. Thus, food handlers appeared to have no formal knowledge of proper hygienic methods of food preparation. It is thus, recommended that training in proper food hygiene practices such as hand washing, storing of food at appropriate temperatures, the use of separate utensils and of gloves be encouraged to add to the existing knowledge of the vendors. Local government and relevant authorities should furthermore provide the vendors with proper resources such as potable water near the vending site as well as an adequate infrastructure. In addition, intervention programmes where the vendors are educated about food safety and hygiene, as well as foodborne illnesses and their prevention, will contribute to the health and well-being of customers and should promote the financial sustainability of the vendors themselves.

Key words: street food, hygiene practices

3.2 INTRODUCTION

In developing countries the informal food vending sector has in recent years grown into a lucrative trade that competes with the formal sector. However inadequate knowledge of food handling practices together with a lack of formal education have been shown to prevail amongst the majority of food handlers (Toh and Birchenough, 2000; Food and Agriculture Organization, 2001). In Africa, the majority of people involved in the business of street food vending have been reported to have attained only low levels of education (Umoh and Odoba, 1999; Codjia, 2000). As a result the majority of food handlers, especially those who prepare food in public places (work places, school surroundings, hospitals, railway and bus terminals), are not familiar with the proper food handling practices that should be adhered to in order to produce safe food. Minimal education standards of street vendors and lack of knowledge regarding safety measures and hygiene contribute to the prevalence of foodborne disease outbreaks (Carolissen-Mackay, 1998).

Despite the vendors' lack of education, a major problem that they have to contend with is working under poor conditions and with inadequate infrastructure. For example, stalls are often made of plastic or are merely crude structures that allow the shedding of dust particles all over the food when it is windy. There is scarcity of running water near the stalls, and toilets and adequate washing facilities are often not available at the vending site (Mensah *et al.*, 2002). Furthermore, during the preparation and food processing stages, food may be contaminated by various foodborne pathogens (Gordon-Davis, 1998; Snyder, 2004). The hands of food

employees could serve as vectors in the spread of foodborne disease as a result of poor personal hygiene or by means of cross-contamination. An employee might, for example, contaminate his/her hands by scratching him-/herself and this could result in pathogens on the fingers contaminating the food (Hobbs and Roberts, 1993; Hemminger, 2000; Ayçiçek *et al.*, 2004). Kusumaningrum *et al.* (2002) and Nel (2003) further point out that bacteria such *as S. aureus, Escherichia coli*, *Shigella* spp., *Bacillus cereus, Salmonella* spp., and *Streptococcus* can survive on hands, sponges, cloths and utensils for hours or days after initial contact with the microorganisms. In a study done by Martinez-Tomè *et al.* (2000), it is reported that 60% of food service personnel neglected to adequately wash their hands, resulting in microorganisms being transferred from hands to food and causing illnesses to consumers.

Previous studies have highlighted problems relating to the occurrence of foodborne illnesses, finding that the three major causes of illness are food that is prepared several hours before being served, inadequate re-heating of food, and inadequate refrigeration of foods (Clayton *et al.*, 2002). Therefore, food handlers who do not carry out proper preparation practices contribute to the high statistics of diarrhoea and other infectious diseases that have been reported as a result of the consumption of contaminated food (Carolissen-Mackay, 1998; Clayton *et al.*, 2002). Practices such as preparing food with uncovered skin abrasions, failure to wash hands after using the toilet or after handling contaminated material, spitting or sneezing and other forms of contamination may contribute to the occurrence of foodborne disease

outbreaks (Carolissen-Mackay, 1998; Trickett, 2000). Proper food preparation practices involve the washing of hands before, during and after food preparation. If this is not done during food preparation, contamination of food by food handlers may result (Nel, 2003).

Recent trends have shown that many people prefer to eat at public places rather than at home (Martinez-Tomè *et al.*, 2000). There are also certain individuals, such as the very young, the elderly, immunocompromised persons, pregnant women, those predisposed to other illnesses and those undergoing chemical treatment, who are at a greater risk of contracting foodborne illnesses than the general population (Hingley, 1997; Scheule, 2004). Hence it is of the utmost importance for food handlers to know how foodborne illnesses occur and how they can be prevented.

The aim of this study was to assess the knowledge of food safety and related hygiene practices of street food vendors in the city of Bloemfontein. Information gathered will be disseminated to the Environmental Health Practitioners in the study area, and will also be used to compile a strategic plan towards improving the safety of street food preparation and handling. The information will furthermore be used in intervention programmes to educate the food handlers on proper food handling.

3.3 MATERIALS AND METHODS

3.3.1 Questionnaire survey (Appendix A)

The study was conducted over a period of four months amongst 45 randomly selected street food vendors in the city of Bloemfontein, Free State Province, South Africa. Questionnaires were compiled and completed using the interview method. Although questionnaires were compiled in English, during the interviews the questions were translated into the respondents' preferred language. These included Sesotho, Tswana and Xhosa. Prior to commencing the interview, the interviewer introduced herself to the respondent, explained the purpose of the survey and confirmed the confidentiality of any information that may be disclosed (Czaja and Blair, 1996). The duration of each interview was approximately 15 minutes.

A series of open and closed ended questions were used and were posed in a simple and concise manner, preventing the respondent from own interpretation. This methodology allowed the interviewer more control over the interview process while also allowing clarification of unclear questions (Azanza *et al.*, 2000; Clayton *et al.*, 2002; Nel, 2003; Walker *et al.*, 2003).

The questionnaire covered various aspects relating to food safety knowledge and practices among the street food vendors and included questions in five categories including a) demographic data; b) cooking and preparation practices; c) personal hygiene practices and health; d) storage practices; and e) sources and suppliers of food.

3.3.2 Pilot study

In order to assess the applicability and clarity of questions as well as to refine the empirical process, a pilot study was conducted using four randomly selected food vendors who were not included in the final sample. Confirmation for the clarity and applicability of the questions were deduced from the answers that the interviewees gave, they showed to have a clear understanding of the questions given.

3.3.3 Checklist (Appendix B)

A checklist was used to assess the physical layout of the stall, the hygiene of the cooking area and the personal hygiene of the food handlers. Observations were scored according to a scale of 0-5, with scores of 0-2 categorised as "poor", 3 categorised as "fair" and 4-5 categorised as "good".

3.3.4 Data analysis

The questionnaires were pre-coded and a code list drawn up. The variables from the questionnaire and the checklist were described by frequencies and percentages for categorical variables.

3.4 RESULTS AND DISCUSSION

3.4.1 Demographic information

The demographic profile of the respondents is presented in Table 3.1 where the present study reflected Sesotho as the predominant language (82%), followed by Xhosa (11%) and Tswana (7%). This could be significant in the sense that the interviewer used the language which is better understood by

the interviewees. The interviewer made it uncomplicated for the interviewees to clearly and easily express their view and ask questions where necessary. The majority of the respondents (96%) were female, with 4% being male. 47% of the respondents (both female and male) were between the ages of 30 and 40, whilst 64% were educated up to grade 9 to 12 level, with grade 12 the highest education level recorded.

Table 3.1: Demographic information of street food vendors in the city of Bloemfontein

Parameter	Frequency (n= 45)	Occurrence (%)
Language		
Sesotho	37	82
Xhosa	5	11
Tswana	3	7
Gender		
Females	43	96
Males	2	4
Age		
19-29	12	27
30-40	21	47
41-50	7	16
51-65	5	11
Level of education		
Grades 1 to 8	16	36
Grades 9 to 12	29	64

Table 3.1 clearly shows that none of the respondents have studied further than secondary level. The demographic profile of the street vendors obtained in this study corresponds with that of similar studies done by Alonsabe (1994) and Ehiri *et al.* (1997) who indicate that the majority of the street vendors surveyed were females of ages ranging from 12 to 63 years. Umoh and Odoba (1999) report that in Nigeria, as in other developing countries, street food vending is a means for income generation amongst predominantly illiterate people, especially women.

3.4.2 Cooking and preparation practices

Table 3.2 represents the number of vendors running each stall. 60% of the stalls had only one person handling all the cooking and cleaning of the stall, while 24% had at least two people. 16% had three people working in the stall. Of the 45 food vendors interviewed, 34 were selling red meat pieces and 11 chicken. All 34 vendors offering red meat used grilling as a means of preparation, whereas chicken was grilled in only two cases. The remaining nine vendors boiled their chicken. The method of preparation used is likely to be dependent on the preference of the consumer, and in South Africa the most popular meals served by street food vendors include grilled or boiled meat together with salads, gravy and vegetables (Mosupye and Von Holy, 1999). 67% of the vendors indicated that they prepare their food both at home and at the vending site, while 11% prepare food only at home and 22% prepare food only at the vending site (Table 3.2). 58% of the vendors used gas as the energy source for preparing food, while 33% used paraffin and 9% electricity.

Table 3.2: Cooking and preparation practices exhibited by the street vendors

Parameter	Frequency (n=45)	Occurrence (%)
Number of people engaged in food handling		
1	27	60
2	11	24
3	7	16
The kinds of food mainly served		
Red meat pieces	34	76
Chicken pieces	11	24
Salad	45	100
Gravy	45	100
Vegetables	45	100
The method of preparation (Grill)		
Red meat pieces	34	100
Chicken pieces	2	18
The method of preparation (Boil)		
Red meat pieces	0	0
Chicken pieces	9	82
Place of food preparation		
Home	5	11
Stall	10	22
Both	30	67
Means of food preparation		
Paraffin stove	15	33
Gas stove	26	58
Electric stove	4	9
Water collection		
Public toilets	1	2
Home	4	9
Onsite tap	19	42
Other	21	47
Left over food		
Throw away	2	4
Take home	43	96

Table 3.2 further indicates that electricity was not utilised optimally at the vending sites because it was not accessible, although it was used by those vendors who prepared food at home. Insufficient paraffin may either lead to food that is undercooked or may cause food to be chemically contaminated (smell of paraffin). Street vendors in the study area had limited access to potable tap water at the vending site (Table 3.2). As a result, they collected water from various sources with 2% reporting that they collected water from nearby public toilets, while 9% brought the water from home (with the consequence that the water collected in the morning was used until the end of the day) (Mosupye and Von Holy, 1999). 42% percent reported that they collected water from an onsite tap, while 47% collected water from other sources such as nearby shops and buildings (Table 3.2).

The consumption of leftover food by customers or vendors and their families is a hazardous practice, because it may cause foodborne illnesses (Azanza *et al.*, 2000). This study shows that 4% of respondents discarded leftovers, while in 96% of the cases leftovers were taken home to families. It was clear from the study that leftover food was not offered for sale again the next day. The methods of dealing with the leftover foods correspond with those found in a study done by Azanza *et al.* (2000).

3.4.3 Personal hygiene practices and health

The personal hygiene practices and state of health of the respondents are presented in Table 3.3. The respondents were questioned about their most recent medical check-up: 42% reported that their most recent health

Table 3.3: Personal hygiene practices and state of health of food handlers

Parameter	Frequency (n=45)	Occurrence (%)
Recent medical check-up		
< 1 month ago	19	42
1-6 months ago	10	22
> 6 months ago	16	36
Preparation of food when ill		
Yes	1	2
Sometimes	44	98
Washing of hands after visiting the toilet		
Yes	44	98
Sometimes	1	2
Washing of hands after sneezing, coughing and smoking		
Yes	45	100
No	0	0
Means of hand washing		
Water	43	96
Water and soap	2	4
Hand drying		
Nothing	5	11
Disposable paper towel	5	11
Towel or cloth	35	78
Definition of hygiene		
Satisfactory	43	96
Unsatisfactory	2	4
Type of toilets		
Flush toilets	44	98
Other	1	2

examination had been a month previously, 22% that they had received a check-up from 1 to 6 months previously and 36% more than 6 months previously. 2% of the food handlers reported that they did prepare food when they were ill, while 98% reported that they occasionally prepared food when they were ill. Gordon-Davis (1998) reports the risk of food contamination as the one aspect which directly originates from food handlers' working practices together with the disease-causing microorganisms that are present in or on the food handler's body. Thus, pathogenic bacteria may be transferred to food via the handling process. Trickett (1997) reports that when a food handler suffers from diseases such as diarrhoea, sore throat, fever, cold or open skin lesions, he/she should report the condition to the supervisor or the manager so that the latter may decide to prevent the worker from continuing with duties until he/she is fit to return to work. However, because in the majority of cases street vending is an individually owned business, vendors are not accountable to supervisors, so the reporting of illnesses is irrelevant.

98% of the food handlers reported that they always washed their hands after visiting a toilet, with 2% reporting that they occasionally washed their hands. Hands serve as a prominent and major vector in the transfer of microorganisms. If the hands are not adequately washed after visiting a toilet or handling contaminated material, bacteria might spread to foods via the food handlers hands (Hemminger, 2000). Van Kampen *et al.* (1998) report that the lack of available hand washing facilities and inadequate knowledge concerning hygiene go hand in hand with improper food handling practices of street food vendors. This was ascertained in a study done in Jakarta,

Indonesia. In the present study the respondents indicated that 96% of the food handlers washed hands with water only, while 4% washed their hands with soap and water. Local legislation clearly stipulates that no person will be allowed to handle food intended for consumption if the hands of such a person are not washed with soap and water (Republic of South Africa, 1999; South African National Standard 10049, 2001).

In order to curb the levels of microorganisms on hands, both Nel (2003) and the Department of Health (RSA, 1997) suggest that soap (preferably in a dispenser) and hot running water be used for washing hands. Legislation further stipulates that all wash-basins shall at all times be provided with an adequate supply of soap, together with disposable paper towels (Republic of South Africa, 2000). However, with the limited facilities under which South African food vendors operate, this has not yet been fully put into practice. In this study 11% of the respondents reported that they do not dry their hands after washing, 11% use disposable paper towels, and 78% use a towel or cloth for drying hands. A definition of "hygiene" was satisfactorily given by 96% of the respondents, and 98% of the vendors indicated that flush toilets were available in close proximity (Table 3.3).

3.4.4 Supplies and storage practices

Without exception, the street food vendors in the study area obtained their meat (both red meat and chicken) from commercial butcheries. Meat from formal suppliers such as butcheries is regarded as acceptable for human consumption, because meat inspectors at abattoirs are obliged by law to

examine the meat before distribution to the butchers. 93% of the vendors buy vegetables from informal markets because they are cheaper and are situated in close proximity to their stalls. With regard to the storage of cooked food, 100% of the respondents indicated that they store food on top of the stove, while 9% of foods prepared at home are stored in a refrigerator. Storing food on top of the stove at ambient temperatures is regarded as an undesirable practice because if food is kept for lengthy periods, it could lead to an undesirable multiplication of bacteria (Mosupye and Von Holy, 1999). All respondents indicated that cooked and raw foods were stored separately at all times to prevent cross-contamination (Table 3.4).

3.4.5 Infrastructure and hygiene practices (Appendix B)

38% of the vending sites were rated as poor, 60% as fair and only 2% as good. Those vending sites without any form of structure surrounding the vendor are rated as 'poor', while the rating of "fair" refers to those sites that had some kind of informal structure facilitating preparation and selling. An example of a "fair" vending site includes a stationary or mobile cart, or any other structure that can assist in preventing dust and pests from contact with food. The rating of "good" refers to a permanent or semi-permanent structure such as a building used for preparing and selling food (Table 3.5). The level of cleanliness of the vendor was rated using a scale of 0-5, with 82% of the vendors rated as fair and 18% as "poor". This impression of the level of cleanliness may be due to the disorderly arrangement of equipment and utensils at such vending sites.

Table 3.4: Sources and suppliers of food and storage practices

Parameter	Frequency (n=45)	Occurrence (%)
Food storage at home		
Top of stove	41	91
Food storage at the stall		
Top of stove	45	100
Storage of cooked foods together with raw foods		
Yes	0	0
No	45	100
Buying of meat		
Butchery	45	100
Buying of vegetables		
General market	3	7
Informal market	42	93

Table 3.5: Personal observation of the layout and hygiene practices of the food vendors

Parameter	Frequency (n=45)	Occurrence (%)
Layout		
0-2 Poor	17	38
3 Fair	27	60
4-5 Good	1	2
Cleanliness		
0-2 Poor	8	18
3 Fair	37	82
Washing of hands before handling food		
Yes	21	47
No	24	53
Use of cutting boards		
Yes	19	42
No	26	58
Washing of cutting boards before use		
Yes	20	44
No	25	56
Chances of cross-contamination due to practices		
Yes	28	62
No	17	38
Staff personal hygiene		
Fair	44	98
Poor	1	2
Presence of pests		
Yes	0	0
No	45	100
Separate storage of cooked and raw food		
Yes	45	100
No	0	0
Covering of hair		
Yes	32	71
No	13	29
Wearing of aprons		
Yes	35	78
No	10	22
Wearing of jewellery during food preparation		
Yes	16	36
No	29	64
Wearing of gloves		
No	45	100

The lack of hand-washing prior to the touching of food, amongst other things, reflected that improper food hygiene practices were followed by 53% of the vendors. The majority of the vendors (58%) did not make use of cutting boards, while the 42% who did use cutting boards did not wash or rinse them before use. The possibility of cross-contamination due to such practices is high, keeping in mind that 56% of the vendors do not wash the cutting boards before using them. The personal hygiene of the food handlers was also rated on a scale of 1-5, where 98% of the food handlers were reflected to practices fair personal hygiene. 2% of the vendors evidenced poor personal hygiene, such as not washing hands between different phases of preparation and not wearing clean clothes. No pests were observed nor signs of their presence in and around the food preparation stall. All vendors stored raw and ready to eat food separate. 71% of the vendors covered their hair during food preparation to prevent loose hair and dandruff from falling into the food. Because hair is known to harbour *Staphylococcus aureus*, it is of the utmost importance for food handlers to wear hair restraints where possible and also to be discouraged from scratching their hair and scalp (Education Foundation, 1992). As well as covering the hair, clean aprons or overalls should be worn (Van Zyl, 1995). The purpose of wearing aprons or overalls is to protect both the food and the food handler from cross-contamination (Canadian Food Inspection Agency, 1990). 36% of the food handlers wore jewellery during food preparation, while 100% did not use gloves as a measure of preventing food contamination via bare hands.

3.5 CONCLUSION

In this study, the following recommendations can be made to enhance the level of hygiene and effectiveness of the vendors: 1) it would be of benefit to employ at least two food handlers to work in one stall, because each person would have the opportunity to concentrate on performing one task at a time, thus limiting the possibility of cross-contamination. As well as this, if the one person is busy cleaning up the vending site or washing dishes, the other one could be doing the cooking, and contamination from hands to food through the handling of unsanitary materials would be minimised. 2) The practice of preparing food at home should be discouraged because in the majority of cases the food prepared at home has been prepared the previous day, without being refrigerated, and the multiplication of bacteria on prepared food may result. 3) The results further indicated that the vendors did not have access to various amenities allowing them to practise safe food hygiene, such as adequate quantities of safe water and sanitation. The Department of Health (RSA, 1997) stipulates that vendors should be provided with a sufficient supply of potable water at all times. Thus, the food handlers will be encouraged to implement good hygiene practices if proper resources and systems are in place. 4) From the results it was observed that the majority of food handlers did not make use of gloves during food preparation. Clean uniforms and the use of clean gloves should be emphasised at all times to food handlers. The gloves worn during food processing should be regularly washed. Ayçiçek (2004) reports that if gloves are properly worn at the right time it contributes positively to hand and kitchen hygiene. Adequate washing and toilet facilities should always be available at the food preparation

establishments (Martínez-Tomè, 2000). 5) In addition, local government and the relevant authorities should play a role in supporting the improvement of street food vending in order to prevent foodborne diseases. The support required should be in the form of adequate infrastructure with supporting services such as water supply, toilets, refuse storage and disposal and waste water disposal facilities as well as training programmes. These services are essential to ensure proper food, personal and environmental hygiene practices and therefore the prevention of foodborne diseases.

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CHAPTER 4

GENERAL CONCLUSIONS

4.1 INTRODUCTION

Numerous researchers have elaborated on the fact that the majority of food poisoning outbreaks are caused by the negligence or ignorance of people involved in the preparation, storage, and distribution or processing of food which results in the introduction of contamination and allows the multiplication of large numbers of food poisoning bacteria. Therefore, food handlers have a responsibility to ensure that food poisoning organisms and other contaminants are not introduced into food by failure to adhere to proper personal hygiene measures or practices. Correct storage of food is a fundamental aspect that contributes to the prevention of contaminants from entering the food and thus also an aspect that contributes to the profitable operation of any food business. Apart from external contaminants, failure to ensure satisfactory temperature conditions can also result in problems of spoilage. If the food contains microorganisms and storage conditions allow multiplication of the organisms, consumers would be exposed to an unacceptable and unnecessary risk. Cleanliness of food preparation personnel as well as of the stalls and the environment will contribute to the reduction of food contamination.

It has been recognised that, for the most part, food served in informal food vending operations is relatively safe for consumption. However, there is ample evidence to indicate potential risks of the occurrence of foodborne disease due to the consumption of contaminated food. Awareness of the potential health hazards that may be posed by activities taking place in street food vending is of paramount importance. The aim of the study was therefore to

quantify the indicator organisms and pathogens detected on beef, chicken and gravy samples as well as on the hands and food preparation surfaces, and furthermore to assess the knowledge and practices regarding food safety amongst street vendors in the city of Bloemfontein. Finally, attempts were made to indicate relationships between selected microbial groups and associated hygiene practices.

4.2 THE PREVALENCE OF BACTERIA ON FOOD, HANDS AND PREPARATION SURFACES OF STREET VENDORS IN THE CITY OF BLOEMFONTEIN

The presence of microorganisms on meat, in gravy and on surfaces sampled in this study is indicative of a degree of ignorance towards proper hygienic practices on the part of food handlers and promotes the possibility of cross-contamination during food preparation. Results indicate that the level of personal hygiene, the use of protective clothing and equipment during food processing (gloves, aprons, hair covers etc.) and proper precautionary measures such as the prevention of cross-contamination, need to be improved. As for the vendors who prepare food at home and transport it to the stall, the method of transportation should be such that no contamination can occur. Proper transportation measures include a clean vehicle which should not carry animals, toxic substances or contaminating materials along with the prepared food. The time required to transport food between the preparation at home and the vending stall or point of sale should not be long enough to allow bacteria to proliferate or to reach infective dose levels (WHO, 1996).

The level of microorganism presence was found to be below the infective dose limit proposed by the Department of Health (2000) and would not pose any notable danger to consumers. The detection of the presence of Coliforms, *E. coli, S. aureus* and *Salmonella* spp. in food and on surfaces, however, showed that better control is needed and that some changes in preparation practices could be made to enhance the microbiological safety of these foods.

The conditions under which the vendors operate during the preparation and selling of food could also partly explain the numbers of bacteria detected on foods: for example, they lack resources and infrastructure such as potable water supplies and adequate toilet facilities. Handling and storage of prepared food also proved to have an influence on the numbers of bacteria detected on the food sold by the vendors in the study area. Therefore, handling of cooked foods should be kept to a minimum to reduce the likelihood of introducing pathogens. Where possible vendors should use clean utensils rather than hands to avoid contamination of food. Where it is impossible to avoid handling such foods, it is essential that the vendors limit the opportunity for any pathogens introduced into the food, to reach infective dose limits.

Bacteria detected in food samples may have been introduced after cooking through cross-contamination from contaminated utensils used by the vendors to serve food, for instance. Serving utensils may have been contaminated as a result of being kept uncovered on the table. The *Staphylococcus aureus* detected on food may have originated from the vendors' hands when touching food preparation areas and dishcloths. In general, based on the findings

regarding microbial contamination it can be concluded that, although much room for improvement exists, the quality of food served by street food vendors in Bloemfontein is generally acceptable.

4.3 KNOWLEDGE AND PRACTICES REGARDING FOOD SAFETY AMONGST STREET FOOD VENDORS IN THE CITY OF BLOEMFONTEIN

Food handling personnel play a significant role in ensuring food safety throughout the chain of production, processing, storage and preparation. Mishandling and ignorance in carrying out proper hygienic measures may enable pathogens to come into contact with food and, in some cases, to survive and multiply in sufficient numbers to cause illness to the consumer. This study showed that many food handlers apply some proper food hygiene principles, even though many of them do not understand the need for these principles. The evidence for this was found during the interviews and through observation of food handlers at the food stalls (Toh and Birchenough, 2000; FAO, 2001).

The reason for serving food of proper quality is to protect consumers' health. Consumers expect to be served food which is wholesome and which will not make them ill. The findings indicate that some of the food vendors prepare food at home and serve it in streets where improper handling during storage and transportation could result in outbreaks of foodborne diseases. Food that is prepared on site may also pose health risks if proper hygiene measures are not adhered to. For food handlers to produce safe and wholesome food they

must be knowledgeable about the hazards that may occur as a result of contamination. Hence, the need for training and educating the food handlers in basic food hygiene is important. Such training programmes should be designed in a manner that will allow the food handler to perceive the reason for practising proper food hygiene measures. Thus, an understanding of the requirements may result in safe food production.

4.4 INTRA- AND INTERRELATIONHIPS AMONGST SELECTED MICROBIOTA AND ASSOCIATED FOOD HANDLER PRACTICES

For the purpose of this study it was deemed important to indicate possible tangible relationships amongst selected microbiota as well as between the microbiota and associated food handler practices. This evaluation was aimed at ascertaining the actual role that food handler practices play in microbial contamination and proliferation, as well as to establish whether the various microbial groups in fact present an accurate and repeatable measure of the true microbial load. In the latter case, such an evaluation should prove the applicability of conventional indicator organisms in the informal sector.

4.4.1 Relationships amongst the various bacterial groups

In order to determine the statistical relationship amongst the various microbiota, Spearman's correlation was used to construct a correlation matrix using five variables: Total Viable Counts, Coliforms, *Escherichia coli, Staphylococcus aureus* and presumptive *Salmonella*. Correlation matrix was

Table 4.1: Correlations amongst the various bacterial groups

BEEF

	[1]TVC	Coliforms	[2]*E. coli*	[3]*S.aureus*	*Salmonella*
TVC		0.687	0.564	0.598	-0.021
Coliforms			0.842	0.635	0.091
E. coli				0.599	0.124
S. aureus					-0.017
Salmonella					

CHICKEN

	[1]TVC	Coliforms	[2]*E. coli*	[3]*S.aureus*	*Salmonella*
TVC		0.641	0.581	0.729	0.112
Coliforms			0.857	0.485	0.375
E. coli				0.348	0.482
S. aureus					0.028
Salmonella					

GRAVY

	[1]TVC	Coliforms	[2]*E. coli*	[3]*S.aureus*	*Salmonella*
TVC		0.797	0.843	0.813	-0.079
Coliforms			0.876	0.832	-0.038
E. coli				0.682	0.028
S. aureus					-0.163
Salmonella					

[1]TVC - Total Viable Counts

[2]*E. coli - Escherichia coli*

[3]*S.aureus -Staphylococcus aureus*

conducted with the aid of a software programme (www.statsguides.bham.ac.uk). In Table 4.1 the correlation matrix of the mentioned variables is shown for beef, chicken and gravy. A strong correlation was noted between TVC and Coliforms detected on beef (r = 0.687), chicken (r = 0.641) and on gravy samples (r = 0.797). Coliforms are sensitive to heat and their presence in food may be a result of recent faecal contamination as well as unsanitary hygienic practices of food handlers (Buchanan, 2000). A moderate correlation (r = 0.598) between TVC and *S. aureus* detected on beef samples was observed. A strong correlation (r = 0.876) was furthermore noted between Coliforms and *E. coli* on gravy. The reason behind this is probably the fact that these microorganisms are both of faecal origin (Cliver, 1990). *E. coli* correlated strongly (r = 0.832) with *S. aureus* on gravy samples. The latter is a principal component of the skin of humans and animals and when detected in high numbers indicates improper personal hygiene of food handlers (Adams and Moss, 1997). In general, the relationships amongst the various microbiota indicated that clear relationship exist amongst those groups that are commonly used in South African legislation (Department of Health, 1972) as indicators of food hygiene in formal establishments such as TVC, Coliforms, *E. coli* and even *S. aureus.* The expansion of these microbial indicators to street foods should thus prove to be effective, even under varying conditions and across a range of products.

4.4.2 Relationships between the various microorganisms detected on beef, chicken and gravy samples and selected practices of food handlers

An analysis was done to determine the relationships that exist between selected food handler practices and microbiota that exist as a result of such practices. The correlations between the various microbial groups and selected preparation practices of food handlers are presented in Table 4.2. In general, no significant relationship existed between microbiota and food handler practices pertaining to beef and gravy, whereas a number of notable correlations were observed between these variables in the case of chicken. Chicken samples showed a moderate correlation ($r = 0.508$) between Coliforms and the washing of cutting boards before they are used. Hands serve as one of the principal agents in transferring pathogens to food. Therefore, when food is handled, regular and thorough hand washing is essential. It is particularly important that hands are washed with soap and water before handling food or equipment, after visiting the toilet, and in between handling raw and cooked foods (Trickett, 2000; Hemminger, 2000; Nel, 2003). *S. aureus* detected on chicken samples correlated strongly ($r = 0.687$) with the food handlers' use of aprons during food preparation. This observation confirms that food handlers should wear clean protective clothing especially in the case of chicken and they must be aware that they are worn to protect the food from risk of contamination. Hair is known to fall out constantly and along with dandruff, this can result in contamination of food. As the scalp often contains pathogenic organisms such as *S. aureus*, hair cover must be worn during food preparation to prevent contamination from this source

Table 4.2: Correlations between various microorganisms and the preparation practices of food handlers

(A) BEEF

Practices	Coliforms	*E. coli*	*S. aureus*	*Salmonella*
Wash hands before touching food	-0.386	-0.247	-0.141	0.125
Wash cutting boards before use	-0.289	-0.299		-0.222
Chances of cross-contamination	-0.134	0.053	0.185	0.185
Hair cover	0.039	-0.034	-0.126	-0.113
Aprons		0.111	0.162	-0.063
Jewellery	-0.098	-0.031	0.005	0.186

(B) CHICKEN

Practices	Coliforms	*E. coli*	*S. aureus*	*Salmonella*
Wash hands before touching food	-0.225	-0.199	-0.314	-0.334
Wash cutting boards before use	**0.508**	0.458	0.236	**0.585**
Chances of cross-contamination	0.024	-0.043	0.391	0.391
Hair cover	0.146	0.423	-0.238	0.174
Aprons	0.336	0.149	**0.687**	-0.208
Jewellery	-0.338	-0.346	-0.016	-0.404

(C) GRAVY

Practices	Coliforms	*E. coli*	*S. aureus*	*Salmonella*
Prepare food when ill	-0.145	-0.109	-0.129	-0.041
Wash hands after visiting toilet	-0.114	-0.109	-0.115	-0.041
Wash hands before touching food	-0.195	-0.204	-0.176	0.261
Wash cutting boards before use	-0.15	-0.095	-0.226	0.077
Chances of cross-contamination	-0.297	-0.253	0.132	0.077
Hair cover	-0.126	-0.043	-0.162	
Aprons	-0.235	-0.219	-0.148	-0.143
Jewellery	-0.243	-0.213	-0.213	0.012

- Variables not included or cells filled with blank returned no results due to little variations in one of the variables.

(Education Foundation of the National Restaurant Association, 1992). A moderate correlation (r = 0.585) was observed between washing of cutting boards before use and levels of *Salmonella* detected on chicken samples.

4.5 RECOMMENDATIONS TO INDUSTRY

The importance of street food can no longer be questioned: the number of people served by this industry, coupled with its ability to assist unemployed citizens to support their families within the study area, shows that these undertakings fill a definite gap in the food provision business. The results of this study allow the following recommendations to be made to the industry:

- Environmental Health Officers need to conduct situation analyses of their respective areas to determine the extent of the problems in terms of existing infrastructure relating to street food vending, and also to establish a system of regular spot checking in order to improve sanitary conditions and to assist vendors to improve hygiene practices in food handling and preparation. The stalls of the vendors should be observed to verify the sources and safety of raw materials and ingredients used in the preparation of street foods. Sources and modes of contamination should be identified through observing food preparation at the street food vending site and by observing food storage practices. Time intervals between preparation, storage and consumption of food should be monitored.

- Local authorities should provide the necessary support to improve street food vending so as to prevent foodborne diseases. The support required should be in the form of infrastructure with supporting services such as potable water supply, toilet facilities, and refuse storage and disposal facilities.
- Before certificates of acceptability can be issued to food vendors, all food handlers should be trained in aspects of basic food hygiene and sanitation.

- Regulations that regulates street vending enterprises and empower vendors to take greater responsibility for the preparation of safe food should be put in place.

4.6 FUTURE RESEARCH

Further research opportunities with reference to this study could include the following:

- a survey of the behaviour of food handlers during food preparation;

- determination of the barriers that prevent food handlers from implementing food safety practices;

- research into the nutritional composition and possible improvement of street foods;

- an analysis of the physical and chemical contaminants associated with street foods such as aflatoxins and heavy metals.

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Appendix A

QUESTIONNAIRE SURVEY

A SURVEY ON THE KNOWLEDGE AND PRACTICES OF STREET FOOD VENDORS IN THE CITY OF MANGAUNG

Introduction:

A. Only vendors who handle, sell or cook foodstuff at the vending site will be interviewed.

B. Your answers to the questions in this questionnaire will be regarded as strictly confidential.

SECTION A: DEMOGRAPHIC DATA

1. Date — For Office Use

2. Vendor number

_____ | | 1-2

3. Which language do you speak?

English	1
Sesotho	2
Other (specify).....	3

	3

4. Gender

Male	1
Female	2

	4

5. How old are you?

_____ Years | | 5-6

6. Level of education:

None	1
Grades 1 to 8	2
Grades 9 to 12	3
Tertiary education	4

7

SECTION B: COOKING AND PREPARATION PRACTICES

7. Approximate number of people engaged in food handling:

_____ people

8

8. Which kinds of food do you mainly serve?

	Type served	Preparation method (1 = Grill, 2 = Boil, 3 = Fry)	
Red meat pieces	1		9-10
Chicken pieces	2		11-12
Salad	3		13
Gravy	4		14
Vegetables	5		15
Beef stew	6		16-17
Chicken stew	7		18-19

9. Where do you prepare your food?

At home	1
At the stall	2
Both	3
Other (specify) _____	4

20

10. How do you prepare your food?

Paraffin stove	1	
Gas stove	2	
Electric stove	3	21
Other (specify) _____	4	

11. Where do you collect water for cooking and washing dishes?

Public toilets	1	22
Bring it from home	2	23
Tap at vending site	3	24
Other (specify)_____	4	25

12. What do you usually do with the leftovers?

Throw away	1	
Reheat and sell	2	
Sell for half price	3	26
Take home	4	
No leftovers	5	

SECTION C: PERSONAL HYGIENE PRACTICES AND STATE OF HEALTH

13. How recently did you undergo a medical checkup?

< 1 month ago?	1	
1- 6 months ago?	2	27
> 6 months ago?	3	
Not at all	4	

14. Do you prepare food at home and/or at the vending site when you are ill?

Yes	1	
No	2	28
Sometimes	3	
Other (specify)_____	4	

.....

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15. Do you wash your hands after visiting the toilet?

Yes	1	29
No	2	
Sometimes	3	

16. If you do, what do you normally use?

Water	1	30
Soap and water	2	

17. Do you wash your hands after sneezing, coughing and smoking?

Yes	1	31
No	2	

18. If you do, what do you normally use?

Water	1	32
Soap and water	2	

19. With what do you dry your hands after washing?

Nothing	1	33
Disposable paper towel	2	
Towel or cloth	3	
Own clothing	4	
Other (specify)_____	5	

20. What do you understand by the term hygiene?

Food and cooking hygiene

- ✓ Wear clean clothes and protective apron
- ✓ Wash hands with warm soapy water
- ✓ Restrain hair with an elastic band or hair net
- ✓ Keeping raw meat apart from cooked meat
- ✓ Washing the cutting board and knife before reusing
- ✓ Wash meat, fruit and vegetables thoroughly before use

.....

Correct	1	34
Incorrect	2	

.....
.....
.....

21. Are toilet facilities available near the vending site?

Yes	1	35
No	2	

22. What type of toilet is available?

VIP toilet	1	36
Bucket toilet	2	
Flush toilet	3	
Chemical toilet	4	
Other (specify)_____	5	

SECTION D: STORAGE PRACTICES

23. Where do you store your food when you are at home?

Refrigerator	1	37
Cooler bag with ice	2	38
On top of the stove	3	39
Other (specify)_____	4	40

24. Where do you store your food when you are at the stall?

Refrigerator	1	41
Cooler bag	2	42
On top of the stove	3	43
Other (specify) _____	4	44

25. Do you store cooked foods together with raw foods?

Yes	1	45
No	2	

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SECTION E: SOURCES AND SUPPLIERS OF FOOD

26. Where do you mainly buy red meat?

Supermarkets	1
Butchery	2
Abattoirs	3
Informal slaughter house	4
Other (specify) _____	5

46

27. Where do you mainly buy chicken?

Supermarket	1
Butchery	2
Abattoirs	3
Informal slaughter house	4
Other (specify) _____	5

47

28. Where do you mainly buy vegetables?

Supermarket	1
General market	2
Informal market	3
Own garden	4
Other (specify) _____	5

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Appendix B

CHECKLIST

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CHECKLIST

SECTION A: EQUIPMENT AND PRACTICES

1. Physical layout of the vending stall

Scale

Poor 0 1 2 3 4 5 Good

Fair

1

2. Cleanliness

Scale

Poor 0 1 2 3 4 5 Good

Fair

2

3. Does the worker wash hands before touching the food?

Yes 1

No 2

3

4. Do they use cutting boards for cutting their food?

Yes 1

No 2

4

5. Do they wash the cutting board before use?

Yes 1

No 2

5

6. Are there opportunities for cross-contamination due to practices?

Yes 1

No 2

6

7. Staff personal hygiene

Scale

Poor 1 2 3 4 5 Good

Fair

7

8. If pests are present which type(s) they are:

Rats	1	8
Cockroaches	2	9
Mice	3	10
Flies	4	11
Other insects	5	12
None	6	13

9. Are raw and ready to eat food stored separately?

Yes	1	14
No	2	

10. Do they cover their hair while preparing food?

Yes	1	15
No	2	

11. Do they wear overalls/aprons?

Yes	1	16
No	2	

12. Do they work with their jewellery on their hands?

Yes	1	17
No	2	

13. Do they wear hand gloves while preparing food?

Yes	1	18
No	2	