INTRODUCTION

CHAPTER I

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"We are what we eat" is an old proverb. The nutritional status, health, physical and mental faculties depend on the food we eat and how we eat it. Access to good quality food has been man's main endeavor from the earliest days of human existence. Safety of food is an inherent component of food quality. "Food safety" implies absence of biological contaminants, adulterants, naturally occurring toxins or any other substance beyond safety limits and that, which may make food injurious to health on an acute or chronic basis.

FBDs are defined as diseases, usually either infectious or toxic in nature, caused by agents that enter the body through the ingestion of contaminated food. Every person exposed to such contaminated food is at risk of FBDs. FBDs are widespread and represent a serious threat to health in both developing and developed countries.

The summary statistics of food borne diseases outbreaks reveal that in the year 2005- 2006 there were about 1616 outbreaks reported of bacterial, viral and parasitic origin. Of these about 223 (14%) outbreaks were of bacterial origin (CDC, 2007).

The epidemiology of food borne disease is changing. New pathogens have emerged, and some have spread worldwide. Many, including *Salmonella*, *Escherichia coli O157:H7*, *Campylobacter*, and *Yersinia enterocolitica*, have reservoirs in healthy food animals, from which they spread to an increasing variety of foods. These pathogens cause millions of cases of sporadic illness and chronic complications, as well as large and challenging outbreaks over many states and nations. In the last 20 years, other infectious agents have been either newly described or newly associated with food borne transmission. *Vibrio vulnificus*, *Escherichia coli* O157:H7 and *Cyclospora cayetanensis* are examples of newly described pathogens that often are food borne (Tauxe, 1997).

Every year, approximately 40,000 cases of *salmonellosis* are reported in the U.S. As many milder cases are not diagnosed or reported, the actual number may be 30 or more times greater (CDC 2008[a]).

A large outbreak of *Salmonella enteritidis* was reported in North East London. This outbreak was due to the consumption of kebab by 94% of the consumers who later developed symptoms of *Salmonellosis* (FoodHACCP.com Information, 2005).

50,000 persons in the US are hospitalized yearly because of *Shigella* and it is found that about 700 persons die early from shigellosis (Baer et al 1999). Upto 3% of persons who are infected with *shigella* may later develop a syndrome that includes joint pain and swelling, irritation of the eyes and sometimes painful urination as well.

One of the most pathogenic serotype is *E.coli 0157:H7*. It is estimated that nearly 73,000 infections by *E.coli 0157:H7* occur in the United states each year, and 61 of those cases are fatal (FSRIO, 2003).

According to CDC, about 2500 people in the United States, develop listeriosis each year. About 20% people with listeriosis die from the infection.

Food samples collected from cafeterias and restaurants yielded strains of enterogenic staphylococci (Soriano et al, 2002). Toxigenic *Staphylococcus aureus* contamination in ready-to-eat (RTE) food is a leading cause of foodborne illness in Korea (Su Kyung Oh et al, 2007).

As many as 148 fresh cases of food poisoning were reported in Dahod from various villages while a woman admitted to Dahod civil hospital died of food poisoning. (Source: Times of India; Date: 26/05/10)

A 14-year-old girl lost her life and about 100 people were taken ill due to food poisoning after they ate sweet bundi at Lakadbari village of Vasda taluka, about 70 km from Surat, in Navsari district on Saturday. (Source: Times of India (Ahmedabad); Date: 19/04/2010)

FDA (2004) and MOH (2001) have outlined five risk factors that need to be evaluated and assessed in complying with safe food preparation and consumption by reducing further food borne illness occurrences. They are, Safe Food Sources, Food Storing Temperature and Stock Control, Personal

Hygiene Practice, Cross Contamination and Safe Temperature of Holding Food.

As the population pressure on a main city increases, there is a tendency to move away from the centre of the city and settle near the suburbs. Thus, long and medium distance commuting has become a way of urban life. This situation has forced an overall change in the pattern of food habits especially in relation to timings, tastes and attitudes. Migration from rural areas to urban centers has also created a daily need among many working people to eat outside the home. Demand for relatively inexpensive, ready – to – eat food has increased as people, especially women, have less time to prepare meals. Greater numbers of people eat meals prepared in restaurants, canteens, fast foods outlets, and street foods. An American Meat Institute (1996) study details lifestyle changes affecting food behavior, including an increasing number of women in the workforce, limited commitment to food preparation, and a greater number of single heads of households. Consumers appear to be more interested in convenience and saving time than in proper food handling and preparation.

Many investigators have reported that food borne illness outbreaks originate in food service establishments (Olsen et al 2000; Jones at al 2004), and sporadic food borne illnesses have been associated with having eaten outside the home (Friedman et al 2004; Kassenborg et al 2004; Kimura et 2004; Sobel et al 2000).

Street foods are ready-to-eat foods and beverages prepared and / or sold by vendors, especially on streets and other public places (Muleta and Ashenafi 2001). Street foods are consumed by an estimated two and a half billion people worldwide. Because of its low cost and convenience, street food is an indispensable part of urban and rural diets in the developing world. In spite of numerous advantages offered by street foods, there are also several health hazards associated with this sector of the economy. Multiple lines of evidence reveal that foods exposed for sale on the roadsides may become contaminated either by spoilage or pathogenic micro-organisms (Bryan et al 1992; Ashenafi, 1995; WHO, 1984). Evidently, street vended foods have shown epidemiological links with illness (El-Sherbeeny et al 1985; Saddik et al1985; Abdussan and Kafertein 1993).

Food stalls often lack the necessary storage, refrigeration and cooking facilities to prevent contamination with pathogenic microorganisms and limited access to running water and waste disposal increases the potential for passing the problem on to many customers (FAO, 2001). Poor hygiene, inadequate access to potable water supply and garbage disposal, and insanitary environmental conditions (such as proximity to sewers and garbage dumps) further exacerbate the public health risks associated with street foods. In a survey of street vended foods by WHO (1996), it was reported that the countries under study had limited infrastructure developments with restricted access to potable water (47%), toilets (15%), refrigeration (43%) and washing and waste disposal facilities.

Another category of food service establishment is the small and medium restaurants that cater food to a major population of the society. A restaurant is a retail establishment that serves prepared food to customers. Food served in such establishments is cheaper and easily affordable. Small restaurants cater mostly to people belonging to low and lower-middle socio-economic class. Customers eating at a restaurant have a right to expect that the food they eat will not harm them. However, customers have no way to control what goes on in restaurant kitchens. They depend on restaurants to follow safe standards of food handling, and on local inspection agencies to enforce those standards. But restaurants can be an important setting for the spread of food borne illnesses. Unlike the street foods, restaurants do have infrastructure facilities such as water supply, electricity, but a limited working area often with untrained staff.

The risk of serious food poisoning outbreaks linked to street foods and small and medium restaurants remains a threat in many parts of the world, with microbiological contamination being one of the most significant problems. Food-borne pathogens are recognized as major health hazards associated with foods prepared in such places, the risk being dependent primarily on the type of food, and the method of preparation and conservation. Lack of knowledge among food handlers as well as owners of the restaurants about the causes of food-borne disease is a major risk factor. Improper use of direct and indirect additives (often unauthorized coloring agents, mycotoxins, heavy

metals and other contaminants such as pesticide residues) are additional hazards in street foods. Although many consumers attach importance to hygiene in selecting a street food vendor, consumers are often ignorant about the health hazards associated with street vended foods. Jay et al (1999) reported that 70% of the food handlers were unaware of the correct temperatures for storing perishables, while 25% failed to identify that washing hands before and during food preparation is necessary. Data on risk factors for food borne diseases indicate that the majority of outbreaks results from faulty food handling practices (Clayton et al 2002). Several observational studies have indicated that food workers frequently engage in unsafe food preparation practices (Clayton and Griffith. 2004; Howes et al 1996; Manning and Snider 1993).

In order to establish a system of safe supply of ready to eat foods to customers either through street food vendors or restaurants of small and medium type, a systematic approach needs to be employed. This process includes involvement of various governmental and non-governmental bodies, which can put in their expertise to achieve this goal. Government has the primary responsibility for identifying and assessing health risks associated with the food supply, and developing national strategies to manage the risks. Canada is of the view of that collaboration of all stakeholders in the food continuum (feed manufacturers, primary producers, food manufacturers /operators, government authorities, consumers) is essential to ensure a comprehensive and integrated approach to the availability of a safe and nutritious food supply (FAO/WHO 2004).

It is essential that the food safety and quality system include proper channels for information and communication between the system and stakeholders in the agrifood chain, with a view to facilitating inter sectoral dialogue and continually improving the safety and quality of food products through education, training and the understanding and adoption of good practices (FAO 2003).

This calls for adopting strategies that would prevent the occurrence of FBD in this group of population. However the traditional approaches, for both food control and for prevention of food borne diseases are insufficient.

For any system to survive and sustain it is necessary that all the bodies join hands and work towards achievement of specified goals. Formation of the 'Canadian Partnership' for consumer food safety education is a testimony towards such joint efforts. The development of Calcutta Model and its success can be attributed to the fact that there was mutual trust and dependence among all stakeholders (Chakravarty I 2006).

In order to prevent food borne illnesses, a contemporary concerted approach including an understanding of good personal hygienic practices, cross contamination and the importance of temperature should be adopted by the food handler. This can be achieved by a combination of an effective food safety infrastructure with an adequate educational program (WHO, 1993). Education of consumers and training of food handlers in safe food preparation is one of the most critical interventions in the prevention of food borne illnesses (WHO, 2002). A food handler must not only know "what" to do, but also "how" and "why" it is being done (Linton, 1995).

In particular, as pointed above, WHO believes that health education in food safety has to be developed in line with the results obtained through the application of HACCP during the preparation and storage of foods in food service establishments. The most important component of imparting education is to train the unskilled workers – the food handlers.

Thus, the instrument of "Food Safety Education" (FSE) should sharpen considerably the consciousness of low level food handlers to achieve high quality food catering service. Angelillo et al (2000) reported that there were inadequacies in knowledge and emphasized the need for educational program to control FBDs and prevent outbreaks in food service industry.

Experience has shown that well designed and implemented educational program is feasible and cost effective means of improving health status. This

statement can hold true only when training is imparted in an effective manner. Varieties of channels along with reinforcement are necessary to make the communication process effective, interesting, entertaining and complete. A study by Sheth and Sukul (2007) showed that food safety education interventions to the mess workers of girl's hostel by using variety of training materials significantly increased the knowledge scores of food handlers from 38.4 percent to 50.2 per cent.

In another food safety education training imparted to Louisiana consumers and food handlers through mass media efforts, including news articles, radio and television and circular letters; and through the "Safe Food Handler" training program conducted at fairs, festivals, schools, day care, nursing homes and other food service establishments resulted in knowledge gains on various aspects of food safety (Impact Reports, 2003).

Study undertaken by Malhotra et al, (2008) also reported that food safety education imparted to 136 food handlers increased their knowledge on food borne diseases increased up to 65%. Another study conducted showed that after a short educational intervention, a significant increase in knowledge about hygienic habits was demonstrated in food handlers (Zacarius et al1991).

According to CDC (2006[a]), food safety education along with several other factors has shown a significant impact in the reduction of several infections from 1996--1998 to 2005. The estimated incidence of infection declined for 6 of the major food borne illness in terms of *Yersinia* (49%), *Shigella* (43%), *Listeria* (32%), *Campylobacter* (30%), *Escherichia coli O157:H7* (29%), and *Salmonella* (9%). Although *Salmonella* incidence decreased overall, of the five most common *Salmonella* serotypes, only the incidence of *S. Typhimurium* decreased significantly 42%.

Thus, imparting FSE training to the street food vendors and handlers of small and medium restaurants will go a long way in reducing FBDs and in the process safeguard the health of the public at large.

Biological hazards are the most common cause of food borne disease linked to fresh fruits and vegetables (CDC 2006[b]; Sivapalasingam et al 2004). Use of raw fruits and vegetables such as onions, coriander, tomatoes, etc by the vendors for the purpose of garnishing the foods or for salad is on the rise. These vegetables are either served raw or undergo very little cooking. Increased consumer demand in recent years for fresh "natural" and "organically" cultivated produce has increased the risk for food handling errors and food borne illnesses associated with fresh produce (Hurst and Schuler, 1992). It has been estimated that the number of produce associated outbreaks per year in the US doubled between the periods 1973-1987 and 1988-1992 (Olsen et al 2000). The epidemiology of food borne diseases has undoubtedly contributed to an increased frequency of outbreaks of infections linked to raw produce. In Australia, fresh produce accounted for 4%of all food borne outbreaks reported from 2001 to 2005 (Kirk et al 2008). Tambekar and Mundhaba (2006) studied the bacteriological quality of salad vegetables sold in Amravati city. Amongst the salad vegetables studied, coriander was found to be predominantly contaminated with *Escherichia coli* and *Salmonella* sp.

Given sufficient time at an appropriate temperature, some pathogens can grow to populations exceeding 10^7 CFU/g of raw produce (USDA 2001). Surveillance of vegetables has indicated that they can be contaminated with various bacterial pathogens including *Salmonella, Shigella, E coli O157:H7, Listeria monocytogenes* and *Campylobacter* (NACMCF, 1999; Beuchat, 1996).

Therefore in order to ensure complete removal of pathogens from fruits and vegetables it is necessary that they are treated with waters having adequate amount of disinfectant. Various sanitizers such as chlorine, $KMnO_4$, chlorine dioxide, bromine, iodine, tri sodium phosphate, quaternary ammonium compounds, organic acids, hydrogen peroxide, etc have been known to disinfect fruits and vegetables. WHO has also stated that vigorously washing fruits and vegetables with safe water reduces the number of microorganisms by 10-100 fold and is often as effective as treatment with 200 ppm chlorine (WHO). Chlorine is the most widely used sanitizing agent for fresh produce (Beuchat 1998; Brackett 1999). Published data indicate that at permitted

concentrations, population reductions on produce surfaces will be within the range of 1–2 log units (Zhuang et al 1995). This is due in part to the rapid breakdown of chlorine in the presence of organic matter in soil and on product surfaces.

Samples of lettuce (n = 144) analyzed from 16 universities for the enumeration of pathogens, that were given wash treatments with sodium hypochlorite or $KMnO_4$ solutions reduced the microbial counts by more than two log units, and total coliforms by at least one log (Soriano et al, 2000). Mathews (2006) studied the effectiveness of washing lettuce for 2min in sodium hypochlorite at 70 ppm or $KMnO_4$ at 25 ppm brought from six college establishments. The incoming lettuce contained counts of nearly 7 log CFU of mesophilic bacteria / gm. Washing lettuce with the above mentioned treatment reduced populations of aerobic bacteria and total coliforms by nearly 2 logs.

Coriander leaves are used in many culinary Indian dishes, for garnishing of cooked foods, or used in the preparation of chutney that under go no thermal treatment. Coriander leaves used in green chutney has been responsible for the outbreak of several food borne diseases (Roday 1999). In Mexico City 20% coriander samples were found to be contaminated with *E coli O157:H7* (Zepeda et al 1995).

Street foods in India make use of coriander leaves for the purpose of garnishing the foods such as *pav bhaji*, curried vegetables, *bhel, pani puri,* etc. The leaves in raw form are used as garnishing and undergo very little cooking. Many a times the leaves are not subjected to washing prior to their use. Such a practice may pose health hazard and is likely source for food borne diseases.

Thus the broad objective of the present study was to study the effectiveness of imparting food safety education to food service providers of urban Vadodara and to determine ways of reducing microbial load on coriander leaves.