

# Food Hygiene and Toxicology in Ready-to-Eat Foods

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# Preface

Ready-to-eat (RTE) foods are very attractive to consumers looking for convenient meals as they provide a source of readily available and nutritious meals. Thus, the production of RTE foods is growing as a result of lifestyle changes and consumers' increased demand for convenience foods. According to the Codex Alimentarius Commission, RTE foods include any food (including beverages) consumed in its raw state or any food handled, processed, mixed, cooked, or otherwise prepared into a form in which it is normally consumed without further processing. The guidelines from the European Commission see RTE food as "food intended by the producer or manufacturer for direct human consumption without the need for cooking or other processing effective to eliminate or reduce to an acceptable level micro-organisms of concern." RTE foods prepared and/or sold by street vendors are recognized as potential vehicles of microbial foodborne pathogens, if they are mishandled during processing and preparation.

Globalization of the food trade is considered to be able to contribute to a more widespread dissemination of hazards affecting food safety. RTE foods infected by pathogenic bacteria, viruses, or mycotoxins may have acute health effects on many affected consumers. Minimal processing applied nowadays to achieve safety, while maintaining other quality attributes, increases the chance of survival of foodborne pathogens and sporeformers. Some bacteria form toxins as byproducts while growing in foods and cause severe food poisoning. Viruses in fresh produce and seafood products can also cause food-based morbidity and mortality.

Consumers are interested in foods that are safe from a toxicological point of view. The nature, sources, and formation of toxic substances in foods, as well as the mechanism of toxic effects, are of importance in order to avoid harmful effects to the consumers. Also, it is important to determine the safety limits of unintended chemicals contaminating foods during various stages of RTE food production. A number of environmental contaminants, that are persistent, can cause problems due to their accumulation through the food chain. Foods contaminated by residues of chemicals that are used as food additives, sanitizing agents, cleaning compounds, and in food packaging may cause chronic health effects to consumers, which are projected over their entire lifetime.

As the public expectation of food safety is high, the efforts to keep RTE foods safe for the benefit and well-being of consumers should be enhanced. This book reviews the challenges associated with microbial and toxicological hazards and provides strategies to minimize the risks associated with the consumption of RTE foods. It is the result of the collaboration of 51 scientists from 27 universities and research centers. My deepest appreciation and thanks go to the chapter authors, who contributed knowledge, expertise, and a significant



amount of their time to bring this book to life. Without their excellent contributions, this book would never have been published. I am also grateful to staff members of Academic Press, Ms Karen R. Miller, Ms Jackie Truesdell, and Ms Carrie Bolger for their helpful advice and assistance during the preparation and completion of this book.

**Parthena Kotzekidou**

# Food habits and the increase in ready-to-eat and easy-to-prepare products

# 1

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## INTRODUCTION

Ready-to-eat and easy-to-prepare (RTE and ETP) meals include a wide range of foods whose composition, importance, and image have transformed over the decades, reflecting the technological developments and changes in uses and customs that have characterized different epochs (Scholliers, 2015). In this regard, the precursors of RTE and ETP meals can be traced back to the products that long ago were made to confront long journeys, such as dried or smoked products, which were easy to preserve and required no particular preparation. With the introduction of glass containers in the 1800s, food preservation took a step forward. It was only 50 years later, however, that food preservation on an industrial scale received a boost from the use of tin, which facilitated food transport and its diffusion over increasingly vaster areas. With the development of industrialized processes, in the 1900s we witnessed the supply of more complex products in tins, which made for a greater variability of assortments, as in the case of sardines in tomato sauce. The preparation of a complete dish was achieved in the early 1950s with TV dinners, made up of a main course, always accompanied by a dressing and a side dish, and packaged in a container that could be heated directly in the oven. The evolution of RTE and ETP meals further developed in the late 1980s with the diffusion of microwave ovens, and the use of these products was no longer limited to particular or emergency situations but instead officially entered the dietary habits of families (Scholliers, 2015). We are currently witnessing yet another transformation of these products in the sense of an expansion of their ranges, accompanied by a strong increase in demand (Scholderer and Grunert, 2005).

To get a better grasp of these phenomena, studies on consumer behavior have analyzed the characteristics of RTE and ETP meals in relation to the preferences of individuals and the evolution of these preferences. This chapter intends to

confront these themes by analyzing the studies reported in the literature, and answering three key questions: “Is there a common denominator that characterizes the different RTE and ETP meals?,” “What are the motives behind their growing demand?,” and “Is there a typical profile of individuals who choose to consume these types of products?” These three questions will be developed in the following sections and constitute the paper’s framework. In the conclusions section we shall discuss the principal arguments in light of possible future scenarios for RTE and ETP meals.

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### **IS THERE A COMMON DENOMINATOR IN RTE AND ETP MEALS?**

The answer to the first question is yes: despite their multifaced nature, it is possible to qualify RTE and ETP meals on the basis of several traits common to all the products belonging to this category. The literature underlines, in particular, that their definition involves two key dimensions. The first concerns those activities for which RTE and ETP meals can determine a benefit for the consumer, while the second concerns the type of benefit associated with the product. Regarding the former aspect, the authors propose to consider all the phases tied to the consumption of food, which include purchase, preparation, and cleaning up, inasmuch as RTE and ETP meals influence, though in different ways, each of these activities (Brown and McEnally, 1993; Darian and Cohen, 1995). As for the type of benefit, the advantages of these foods are to be sought in their convenience in terms of time, physical energy, and mental effort (Brunner et al., 2010).

These considerations permit us to extrapolate the common denominator of RTE and ETP meals, and thus arrive at the following definition: “RTE and ETP meals are food products that help save time, physical energy, and mental effort in all food activities compared to what is required for meals prepared from raw materials.” This characteristic represents an answer to the demands of an increasingly more time-constrained society in which fewer opportunities to prepare meals lead to a progressive substitution of the homemade with the more convenient (Ryan et al., 2002). In this context, convenience becomes a decisive attribute of the consumer’s preferences and a determining factor in food choice on a par with other product attributes such as taste, price, or health traits (Candel, 2001; Grunert, 2006).

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### **WHAT ARE THE MOTIVES BEHIND THE GROWING DEMAND FOR RTE AND ETP MEALS?**

Numerous studies have observed a growing demand for convenience foods in various countries (Casini et al., 2015; Rischke et al., 2015; Smith et al., 2013). On the macroeconomic level, the reasons for the success of RTE and ETP meals

are traced to the growth and technological progress that have increased the consumers' assets and facilitated the conservation and transformation of foods (Jabs and Devine, 2006). Other factors can be identified in family structure and organization. These include the woman's participation in the world of work, the extension of work hours (Buckley et al., 2007; Senauer et al., 1991; Traill, 1997), and the growth of single-member units, which have played a decisive role in increasing the demand for quickly prepared foods (Khan, 2000; Swoboda and Morschett, 2001; Verlegh and Candel, 1999).

While the aforementioned elements may constitute some of the most macroscopic factors that can be correlated to the increase in convenience food consumption, for a proper understanding of the phenomenon we must shift our attention from the objective characteristics of consumers and available resources to the subjective aspects. In this ambit, the literature points out two major fields of analysis. The first concerns beliefs, intended as the individual's perception of the outcomes of a certain behavior, the expectations of the "others" and the capability to perform a particular behavior (Ajzen, 1991, 2011). The other field concerns the value system and the ways individuals pursue personal values (de Boer et al., 2004; Brunsø et al., 1996; Schwartz, 1992).

The answer to the initial question as to the success of convenience foods therefore requires a closer examination of these concepts. The two following sections will describe the behaviors of consumers that emerge from the studies conducted by applying theories based on beliefs and values, in view of reaching an answer capable of explaining the growing demand for RTE and ETP meals.

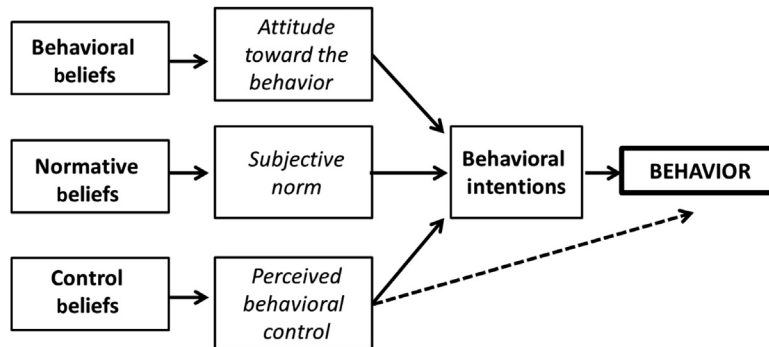
## **BELIEFS, ATTITUDES, AND BEHAVIOR**

In the field that analyses the connection between behavior and beliefs, the study of convenience orientation has been confronted using the cognitive model known as the theory of planned behavior (TPB), which proposes a structured approach to explain the behavior of individuals (Ajzen, 1991, 2011).

At the basis of the model are the beliefs, shaped into behavioral, normative, and control beliefs (Ajzen, 1985). The first are defined as the expected outcomes of a particular behavior. They are weighed on the basis of a personal evaluation of these outcomes, generating the attitude towards the behavior, which can be positive or negative.

Normative beliefs concern the perception of the expectations of family members, friends, and other important referents. Along with personal motivations in satisfying the expectations of others, they are responsible for the social pressure to adopt (or not to adopt) a particular behavior.

Finally, control beliefs express the perception the individual has of his/her own assets in terms of resources, skills, and opportunities to adopt a particular behavior. The individual's evaluation of the power of the aforesaid resources to facilitate or oppose the behavior determines the perceived behavioral control. According to the TPB, the connection between beliefs and behavior is represented



**FIGURE 1.1**

Schematic representation of the theory of planned behavior.

by intention, defined as the individual's inclination to adopt a particular behavior. The consequences of intention on behavior are moderated by the perceptions of behavioral control, in the sense that a favorable intention produces the behavior only if the perceived behavioral controls favor the behavior (Fig. 1.1).

The studies conducted in the ambit of RTE and ETP meals have analyzed the factors that can influence purchase behaviors; these factors can be traced to all three categories of beliefs, though the behavioral beliefs and therefore attitude proved to represent the best predictor of the behavioral intention to buy convenience foods (Olsen et al., 2010; Mahon et al., 2006). The importance of attitude on behavior has also been verified by Scholderer and Grunert (2005), who pointed out a stricter form of mediation between attitude and behavior, showing how all effects of perceived resource constraints (perceived behavioral controls) on choice were completely mediated by consumers' attitudes. The literature highlights that among the principal behavioral beliefs emerge value for money, time-saving, taste, healthiness, and weight control. In particular, value for money has been found to exert a positive influence on the attitude to purchase these products (Brunner et al., 2010; Buckley et al., 2007; de Boer et al., 2004; Ryan et al., 2002), along with time-saving (Buckley et al., 2007), while taste, healthiness, and weight control can carry a negative influence (Olsen, 2012).

While the behavioral beliefs described here have a fundamental role on purchase behavior, studies have pointed out the influence of normative and control beliefs as well. Among the former, social pressure can constitute a restraint to consumption by generating a sense of guilt for the limited care dedicated to preparing food, both in terms of time and of mental effort (Costa et al., 2007; Olsen et al., 2010; Olsen, 2012). In this same ambit, other elements that limit the consumption of RTE and ETP meals are tied to the regret for the loss of family meal-time and of the culinary traditions to pass down to one's children (Dunn et al., 2011). The influence of these factors on the consumption of convenience foods is variable.

On the territorial level, these differences appear to be attributable to a different market exposure. In particular, in countries where there is a high penetration of these products, such as Holland, nonsignificant results are observed for the effect of subjective norm on the intention to consume ready-to-eat meals (Buckley et al., 2007; Olsen et al., 2010).

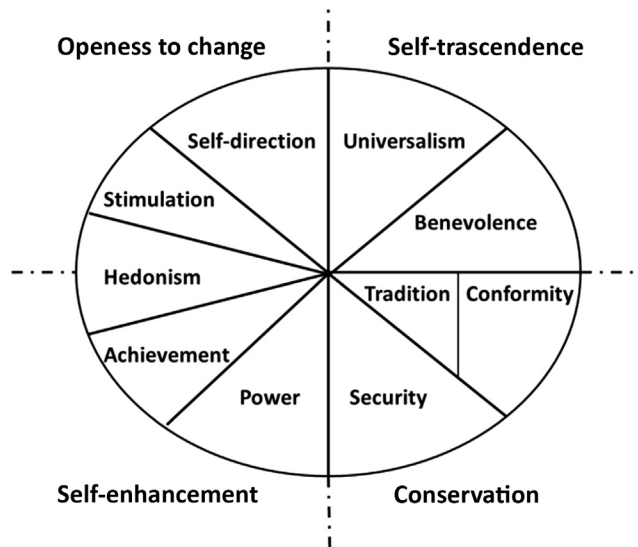
Among the control beliefs, time pressure is identified as a key factor in encouraging the intention to purchase convenience foods (de Boer et al., 2004; Ryan et al., 2002; Verlegh and Candel, 1999). In terms of skills, scarce cooking ability is associated with a greater use of RTE and ETP meals (Brunner et al., 2010; Buckley et al., 2007). Moreover, in terms of opportunities, a different stance towards these products is associated with their variety, quantity, and diffusion (de Boer et al., 2004; Sloan et al., 1984). Likewise, the consumption of convenience foods is connected with the technological development and utilization of appliances suitable for RTE and ETP meals, such as microwave ovens or freezers (Buckley et al., 2007).

## VALUE SYSTEM AND FOOD-RELATED LIFESTYLES

In analyzing the values system to understand the consumer's behavior, values are defined as the higher-order reasons that guide the individual in evaluating stimuli, and represent the most abstract level of cognition (Schwartz, 1992). In other words, they are the desirable end-states that orient behavior. These are universal categories that, as such, do not depend on a specific situation but can instead vary from individual to individual, depending on the relative importance he/she attributes to them.

Schwartz (1992) indicates 10 value domains, the achievement of each of which can determine an effect that is congruous or in opposition to the other domains. These relationships are summed up into two bipolar dimensions represented by self-enhancement versus self-transcendence, and openness to change versus conservation. Self-enhancement expresses power and achievement, while self-transcendence represents universalism and benevolence. On the other hand, openness to change represents values such as stimulation and self-direction, while conservation embraces tradition, conformity, and security. Finally, the hedonism value shares parts of both openness to change and self-enhancement (Fig. 1.2). Therefore, those who consider security as the most important value, for example, will be more mindful of food safety, while those who prefer stimulation will look for novelty and excitement, even to the detriment of security. Likewise, the individuals who mainly pursue benevolence will devote attention to the influence of their choices on the wellbeing of the society, while those who consider hedonism more important will attribute greater weight to appeal, relegating considerations of a social nature to second place.

In order to study the influence of personal values in the ambit of food-related behavior, a set of cognitive categories has been proposed, which goes under the name of food-related lifestyles (Brunso et al., 2004; Scholderer et al., 2004). This construct makes it possible to relate the higher values to the way individuals employ food and eating. By utilizing this approach, studies have pointed out how



**FIGURE 1.2**

Schwartz value system.

the convenience orientation is determined by different value categories, depending on the socio-territorial context considered. In Germany, in fact, it is associated with the power domain, which includes values such as social status and prestige. In Spain, an association of convenience foods with the search for an exciting life is underlined, and the convenience orientation is more connected with stimulation, which reflects boldness, novelty, and challenge in life (Brunso et al., 2004). On the other hand, in Greece, Botonaki and Mattas (2010) have divided the convenience orientation into its various constituent elements, shedding light on how dealing with cleaning up in a convenient way proves to be correlated with power, while the preference for takeaways is associated with openness to change. Finally, the orientation towards purchase and consumption is principally correlated to the achievement domain, which concerns values such as personal success, competence, and ambition in the professional field.

## THE MOTIVATIONS OF SUCCESS

The increase in available income, along with several changes that have occurred in the organizational structure of families have constituted, in many countries, the basis for a development of RTE and ETP foods consumption. The actual growth in demand, however, can be explained more thoroughly only by also considering the changes that have occurred in the beliefs and values systems of individuals, which are in turn connected to changes in supply.

The analysis of the results of applying the TPB points out, first of all, the importance of the increase of time pressure as a determinant of the phenomenon. Furthermore, the reduction of cooking skills represents the other factor that has contributed to increasing the purchasing behavior of these products. The increased interest in convenience foods that has evolved has, in turn, generated major improvements in their supply in terms of quality, quantity, and distribution. In particular, the development of new products associated with a better taste and healthiness may have contributed to improving the expected behavioral outcomes and, consequently, encouraged a positive attitude towards these products, further boosting their consumption. Moreover, the greater market penetration of convenience foods may have attenuated the negative social pressure against the consumption of these products, which are increasingly less associated with a lack of care and attention towards family and guests in moments of conviviality (Buckley et al., 2007). Again from the perspective of supply, the increase in the number of places where convenience foods are available, and the variety of the foods distributed has improved the access to these foods, thereby encouraging their consumption.

Another factor that has acted positively on the perceived behavioral controls is represented by the diffusion of new technologies that in facilitating the conservation and preparation of convenience foods have enhanced their capability to reduce the time and effort associated with meals and, in turn, also contribute to improving consumers' attitudes towards them.

As far as the value system is concerned, the analysis of the literature presents a variegated picture with various aspects, which allows us to add an important element to answer the question as to the motives that have led to an increase in the demand for convenience foods: the increased interest in RTE and ETP meals has been encouraged by a significant shift in the value system. In particular, there has been a passage from the dimension of self-transcendence to that of self-enhancement and a greater inclination towards change, to the detriment of the dimension of conservation, associated with harmony and the stability of family and society (Cerulo, 2008; Sharma and Sharma 2010).

Lastly, combining the TPB and the approach of food-related lifestyles permits us to offer a more exhaustive answer to the question that opened this section: the motives behind the growing demand for RTE and ETP meals can be traced to a combined change in the behavioral, normative, and control beliefs, and of the way the consumer evaluates them. In particular, while on one hand we witness a transformation of the characteristics of convenience foods that improve their use and image, on the other hand, there is a shift in the value system that leads to a change in the opinion of the individual, as well as in that of society overall. Thus the individual is faced with an increased availability, variety, and quality of convenience foods, which make these food products increasingly more accessible and respondent to one's own tastes and lifestyles. On the other hand, the change in the system of individual and collective values affects the evaluation of the expected outcomes and the subjective norms, increasing the consumer's interest and, at the same time, lowering the barriers to consumption.



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## IS THERE A TYPICAL PROFILE OF INDIVIDUALS WHO CHOOSE TO CONSUME RTE AND ETP FOODS?

The studies on the consumer profile of RTE and ETP foods, though conducted in different contexts, have pointed out characteristics shared by the purchasers of this category of products. They are, in particular, prevalently male, single, young people (Brunner et al., 2010), people without children (Buckley et al., 2007; Candel, 2001) and with longer working hours (Candel, 2001). This set of sociodemographic and objectively observable traits proves to be coherent with the picture of the system of beliefs and values described in the previous paragraphs. Integrating the results of the studies on sociodemographic profiles with the values and perceptions represents the most comprehensive way to acquire an effective understanding of the most significant convenience-oriented market segments.

The characteristic of having a job commitment for many hours of the day is certainly tied to the control belief of time pressure. People with a higher role overload (Brunner et al., 2010; Buckley et al., 2007; de Boer et al., 2004; Candel, 2001) can perceive a greater time pressure, which could be translated into a more marked inclination to consume convenience foods. On the other hand though, this relationship is not essentially one of cause and effect, inasmuch as the inclination towards convenience foods can be determined by many other elements that affect time pressure, in addition to or even in opposition to the length of working hours, such as engaging in other high-involvement activities or daily travel time. Proper profiling would therefore require integrating the work time characteristic with other elements capable of better defining the presence of the individual's time pressure condition, though with the awareness that time pressure has marked features of subjectivity and can thus vary from one individual to another, even under the same objective conditions.

Age proves to be another important sociodemographic trait in defining the inclination towards convenience foods. In this regard, young age can be connected with fewer skills, low cooking involvement, and other values positively correlated to the consumption of these products. In fact, young people present a greater individualism (Danesi, 2012), which shows in the habit of breaking meal times, eating alone, snacking, and in the limited involvement of family members in meal activities, factors that characterize convenience-oriented consumers (Jabs and Devine, 2006). Furthermore, young people also show more openness to novelty and a greater inclination towards change (Ebner et al., 2006), all elements that characterize this category of consumers (de Boer et al., 2004).

Analogous considerations can also be made for the characteristics of gender, living alone, and presence of children. In particular, males generally prove to have fewer cooking skills, single persons show less inclination to preparing a proper meal when eating alone (Brunner et al., 2010), and families without children are associated with being less sensitive towards the health-related characteristics of food (Grunert and Wills, 2007), and thus prove more open to foregoing freshness in favor of convenience (Buckley et al., 2007).

The relationships described above point out how it is possible to outline a profile of the “typical” convenience food consumer by integrating the objectively verifiable elements, such as demographic characteristics, with the values and beliefs of individuals, as explanatory factors of the connection between the observable characteristics and the preferences of consumers.

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## DISCUSSION AND CONCLUSIONS

Our study permits us to select several explanatory elements of the role RTE and ETP foods assume in the scenario of consumption. Two principal aspects emerge in the ambit of values: the first is curiosity to try new ways of eating; the second is the individualist food behavior in which the personal interest prevails over that of the family in decisions concerning consumption. In the ambit of beliefs, we can note the importance several factors have on consumer behavior, first and foremost, the control belief of time pressure, which acts as a catalyst in the choice process of RTE and ETP foods. As far as behavioral and normative beliefs are concerned, a positive role is played by the quality traits of the supply and by market penetration, which respectively affect the attitude towards convenience products and loosen the normative barriers connected with social pressure.

It is not easy to foresee the future scenario of RTE and ETP meals, insofar as the development of these products is a function of the structural relationships between objective factors—such as time, skills, or the availability of products—and subjective factors concerning their perception (Scholderer and Grunert, 2005).

The reasons for the recent popularity of RTE and ETP meals, tied to the improvement of the quality characteristics of supply and to changes in the value system and lifestyles, in any event allow us to glimpse a future scenario of further expansion in the food habits of these products, at least for some categories of individuals.

The conclusions that the literature has come to in terms of profiling the convenience-oriented consumer cite, as fundamental characteristics, time pressure, youth, and scarce cooking skills, which thus offers several important elements to foresee the future of these foods. The segment of young people, which currently shows a marked interest in these products, in the future will constitute the group of consumers with the greatest purchasing power, and will therefore be able to also exert a growing influence on overall food demand. The supply of quickly prepared foods with high contents of quality and healthiness, though more expensive, could therefore be an interesting strategy to develop.

From the public viewpoint, in this framework, a growing diffusion of RTE and ETP foods can determine the advisability of effective food education campaigns and greater attention to the rules that regulate the production of these foods, both in terms of preparation techniques and of ingredients. In this regard, mandatory labeling constitutes a fundamental tool to permit informed consumption.

The public administration's adoption of this orientation could bring about a synergy between the needs for complete and correct information, the improvement of supply characteristics, and the consumer's greater willingness to purchase. The guarantee offered by the regulations could indeed provide the consumer with a tool to bypass several barriers that, as we have seen, negatively affect beliefs and, at the same time, reward the companies that offer the best-quality products.

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# Safety of street foods

# 2

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## STREET FOODS: DEFINITION AND BASIC CHARACTERISTICS

Nowadays, an estimated 2.5 billion people consume street foods in some form every day (Fellows and Hilmi, 2011; Kraig and Sen, 2013), and street foods are considered as the most dominant form of public dining (den Hartog et al., 2006; Kraig and Sen, 2013). Street foods are very familiar and sold as quick meals or snacks from daybreak until night in almost every corner of the world (Fellows and Hilmi, 2011; Tinker, 1997). Street foods are widely obtainable in both urban (den Hartog et al., 2006; Fellows and Hilmi, 2011; INFOSAN, 2010; WHO, 1996) and rural (Fellows and Hilmi, 2011; WHO, 1996) settings, and offer an easy substitute to home-cooked food (Winarno and Allain, 1991).

Street foods are low-priced meals compared with restaurant foods (Fellows and Hilmi, 2011; INFOSAN, 2010; Kraig and Sen, 2013; WHO, 1996; Winarno and Allain, 1991), and that's why these foods are easily accessible and affordable for large numbers of underprivileged people in many areas of poverty, particularly in many developing countries (den Hartog et al., 2006; FAO, 2007; Fellows and Hilmi, 2011; INFOSAN, 2010; Kraig and Sen, 2013; WHO, 1996). Street food is also a convenient source of attractive food for tourists and the economically privileged (FAO, 2007; INFOSAN, 2010; Kraig and Sen, 2013; Tinker, 1997; WHO, 1996). Street foods are an important source of daily calories and nutritional requirements for many people (den Hartog et al., 2006; FAO, 2007; Fellows and Hilmi, 2011; INFOSAN, 2010; Kraig and Sen, 2013; Tinker, 1997; WHO, 1996; Winarno and Allain, 1991). The nutritional value of street foods depends on their ingredients and methods of preparation (den Hartog et al., 2006; Fellows and Hilmi, 2011).

Street foods have been available for thousands of years, and reflect traditional local and regional cultures (Fellows and Hilmi, 2011; INFOSAN, 2010; Kraig and Sen, 2013; Tinker, 1997; Winarno and Allain, 1991). Cultural, ethnic

and religious diversities influence the type and nature of such foods (Fellows and Hilmi, 2011). These foods are prepared and consumed based on local traditional knowledge, and usually stick to the seasonality of farm production (Fellows and Hilmi, 2011). The street food sector plays an important role in providing employment opportunities for millions of men and women with inadequate education or skills and limited capital investment (den Hartog et al., 2006; INFOSAN, 2010; Roever, 2014; WHO, 1996; Winarno and Allain, 1991). Furthermore, this sector has become a significant part of the food distribution system, especially for midday meals in both developing and developed countries (INFOSAN, 2010).

In 1986, the Food and Agriculture Organization of the United Nations (FAO) defined the term “street foods” as:

*a wide range of ready-to-eat foods and beverages sold and sometimes prepared in public places, notably streets*

**Winarno and Allain (1991).**

This definition of street foods was accepted by the FAO Regional Workshop on Street Foods in Asia, held in Yogyakarta, Indonesia, during Nov. 3–7, 1986.

In 1988, an FAO Expert Consultation on Street Foods (held in Yogyakarta, Indonesia, during Dec. 5–9, 1988) defined “street foods” as follows:

*Street foods are ready-to-eat foods and beverages prepared and/or sold by vendors and hawkers especially in streets and other similar public places*

**den Hartog et al. (2006), Draper (1996), FAO (1989), FAO/WHO-CAC (1999), Fellows and Hilmi (2011), INFOSAN (2010).**

Although several attempts have been made to define “street foods,” this is the most widely cited definition so far.

The World Health Organization (WHO) has defined “street-vended foods” or its equivalent “street foods” as:

*foods 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*

**WHO (1996).**

This definition includes fresh fruits and vegetables that are vended for immediate consumption.

**Tinker (1997)** defined street food as:

*any minimally processed food sold on the street for immediate consumption*

**Tinker (1997).**

In order to make it clear, Tinker refined her definition of street foods by including fresh fruits that are sold on the streets (eg, one or two bananas, not a large bunch of bananas), and by excluding nonnutritious chewing foods (eg, chewing gum, or chewing “paan,” ie, betel leaf with betel nut, lime, and spices) (Tinker, 1997).

While Tinker concentrated on minimally processed foods for immediate consumption, the diversity of street food production and consumption has been emphasized in another definition:

*Street foods are minimally processed to highly processed foods that are sold on streets and other public places, consumed on the spot and/or ready to take home or delivered to the work place, including catering activities that can serve celebrations such as weddings*

**Fellows and Hilmi (2011).**

In an encyclopedia of food and culture, **Kraig and Sen (2013)** stated an ordinary definition of the term “street food” as:

*a food prepared by a vendor and sold from an open-air stand, cart, truck, or perhaps a market stall*

**Kraig and Sen (2013).**

The key feature of street foods mentioned in the definitions above is the retail location “on the street.” Typically, street foods are sold on the street from pushcarts, bicycles, baskets, balance poles, or from stalls or shops that do not have four permanent walls (**Draper, 1996; Fellows and Hilmi, 2011; Tinker, 1997**). This retailing method differentiates street food vendors from other formal food service establishments, such as cafés, “takeaways,” “chopbars,” and restaurants (**Draper, 1996; Fellows and Hilmi, 2011**). Vendors’ stalls are usually situated in the open air or under a roof that is easily accessible from the street (**Winarno and Allain, 1991**). Because street foods are often sold in a place where people gather for shopping or recreation purposes, the places where these foods are served may include not only streets, but also outdoors and enclosed markets where individuals vend different commodities (**Kraig and Sen, 2013**). Amusement venues, such as carnivals, fairs, athletic events, footpaths, around factories and offices, bus and train stations, schools and colleges, and crowded residential areas, are some places for selling street foods (**den Hartog et al., 2006; Kraig and Sen, 2013**). The types of street food vending operations may vary in different regions of the globe. Vendors can be mobile or ambulatory vendors, for example, simply on foot or using bicycles, pushcarts, vans, or stationary vendors that sell from a fixed stall which may be a permanent or semipermanent structure (**den Hartog et al., 2006; Draper, 1996; Fellows and Hilmi, 2011; INFOSAN, 2010; WHO, 1996**).

Street foods exist in a limitless variety (**den Hartog et al., 2006; Draper, 1996; Fellows and Hilmi, 2011; INFOSAN, 2010; Kraig and Sen, 2013; WHO, 1996; Winarno and Allain, 1991**) comprising meals, drinks, and snacks (**Draper, 1996; INFOSAN, 2010; Winarno and Allain, 1991**), while Kraig and Sen categorized actual street foods as snacks, junk food, and basic foodstuffs in their *Encyclopedia of Food and Culture* (**Kraig and Sen, 2013**). Ranging from simple snacks to elaborate dishes, street-vended foods may include foods as diverse as meat, fish, fruits, vegetables, grains, cereals, frozen products, and all



sorts of beverages (den Hartog et al., 2006; WHO, 1996). Street foods also show extreme diversity in terms of raw materials or ingredients, methods of preparation, processing, and consumption (Draper, 1996; Fellows and Hilmi, 2011; INFOSAN, 2010; Winarno and Allain, 1991).

Street foods can be produced in several ways: (1) many are centrally processed foods produced by formal commercial industries or manufacturers; (2) others are processed foods within the street food trade, either by the individual vendor him/herself or their families, or by another small-scale entrepreneur (Draper, 1996; Kraig and Sen, 2013). There are differences in the spots where street foods are prepared, such as small-scale food factories or traditional workshops, vendor's homes, markets, or streets (INFOSAN, 2010). The final preparation of street foods occurs when the customer places an order for the meal. The food is prepared instantly from premade ingredients and served in an appropriate manner, which can be consumed on the spot or on the move, or taken away (Kraig and Sen, 2013; Tinker, 1997; Winarno and Allain, 1991).

Tinker (1997) introduced the term "invisible street foods" as: "ready-to-eat food that was carried through the streets by the preparer rather than the purchaser, for eating at home or office, and was not for sale on the street" (Tinker, 1997). This type of street foods is prepared in or served from the basement of an office building or from a nearby home, and delivered to the workers on a regular basis. Because the foods were not vended from a visible shop or cart, they were termed "invisible" (Tinker, 1997).

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## SAFETY OF STREET FOODS: A MAJOR CONCERN

Despite many potential advantages, it is recognized that street foods may pose significant public health risks (WHO, 1996). Microbiological contamination is the most important health hazard associated with street foods, while the use of unpermitted chemical additives, pesticide residues, transmission of parasites, and environmental contamination have also been considered as other possible health risks (Abdussalam and Kaferstein, 1993; Arambulo et al., 1994). Many factors are responsible for these health problems, such as lack of basic infrastructure and services (eg, potable water supplies), general lack of factual knowledge about the microbiological status of street foods, insufficient resources for inspection and laboratory analysis, poor knowledge of street vendors in basic food safety measures, and inadequate public awareness of hazards posed by certain street foods (WHO, 1996). Moreover, it is too difficult to control the large numbers of street food vending operations due to their diversity, mobility, and temporary nature (WHO, 1996). Because food is susceptible to contamination at any phase of the food chain from origin to consumption (Kraig and Sen, 2013; Tinker, 1997; WHO, 1996), the safety of street foods is a point of major concern, particularly in overcrowded streets and public places (den Hartog et al., 2006; Draper, 1996; FAO, 2007).