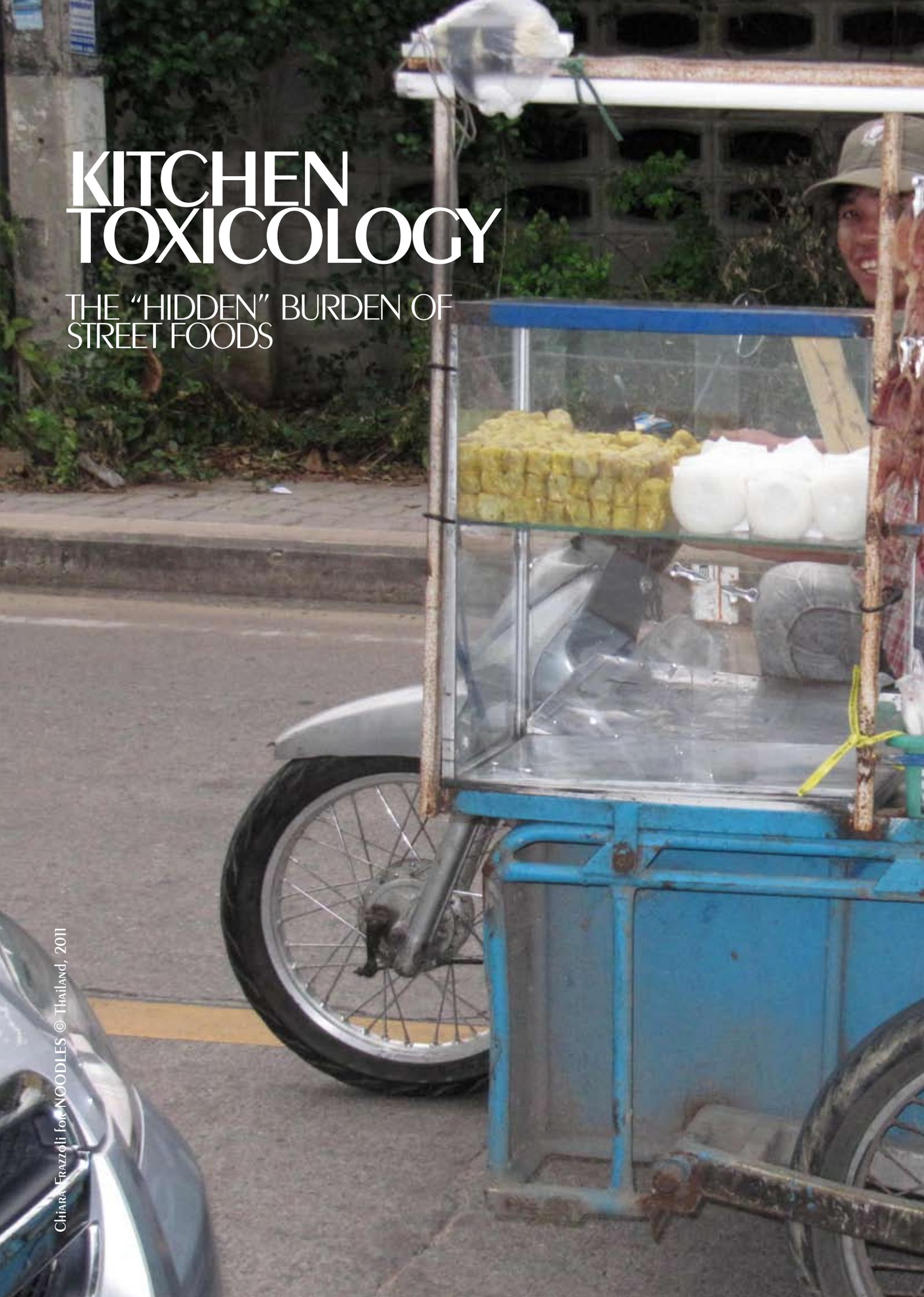


KITCHEN TOXICOLOGY

THE "HIDDEN" BURDEN OF
STREET FOODS





THE “HIDDEN” BURDEN OF STREET FOODS



OPINION

by **ILARIA PROIETTI**

ilaria.proietti@noodlesonlus.org

PhD in Food Quality and Safety, Istituto Superiore di Sanità, Rome, Italy.

IL RISCHIO “NASCOSTO” DEL CIBO DI STRADA

La vendita di cibo di strada rappresenta ormai una componente indispensabile del sistema alimentare di molti Paesi in via di sviluppo, grazie anche al processo di urbanizzazione che si sta diffondendo sempre di più in queste regioni, e contribuisce significativamente alla sicurezza alimentare delle persone che fanno affidamento sulla loro vendita e/o disponibilità. Grazie alla vasta presenza sul territorio, al basso costo e all'offerta molto variata di alimenti, il cibo di strada rappresenta, inoltre, un importante mezzo di sussistenza per le comunità a basso reddito.

Nonostante i benefici nutrizionali, sociali ed economici, la vendita di cibo di strada suscita grandi preoccupazioni per la salute della popolazione urbana. La principale preoccupazione è legata alla sicurezza alimentare, ovvero all'igiene e alla qualità degli alimenti, soprattutto a causa della possibile presenza di agenti biologici e/o sostanze chimiche nei prodotti alimentari venduti al pubblico. Nel corso degli anni il rischio microbiologico è stato ampiamente studiato, mentre resta ancora molto da chiarire sui pericoli chimici/tossicologici e, in particolare, sulle misure da adottare per prevenire e/o ridurre la probabilità della loro presenza.

L'obiettivo di questo documento è quello di descrivere i rischi chimici/tossicologici a cui esposto il cibo esclusivamente preparato sulla strada, al fine di: identificare e caratterizzare i principali pericoli chimici/tossicologici e valutare il rischio di esposizione della popolazione generale. A partire dalla vulnerabilità intrinseca delle matrici alimentari a diverse sostanze chimiche, vengono quindi esaminati punti critici di controllo: come la locazione del punto vendita, lo stoccaggio e la preparazione dei piatti pronti, allo scopo di fornire ai venditori di cibo di strada le informazioni necessarie per prevenire e/o ridurre la presenza di sostanze tossiche nei loro prodotti e tutelare, così, la salute del consumatore.

SUMMARY: Street-vended foods (or street foods) are an indispensable component of the food system in many cities of developing countries, increasingly emphasized by the rapid urbanization process, and significantly contribute to the food security of people who rely on their daily and widespread availability. Due to their easy accessibility and diversified supply of meals, street foods also represent an inexpensive and accessible means for low income communities of meeting their basic nutritional needs.

Despite the nutritional, social and economic benefits that may originate from it, the selling of street foods raises serious concerns for the health of urban population. The major concern is related to food safety, in particular due to biological agents and chemical substances in food products presented to the public. Over the years, the microbiological hazards have been deeply examined, though proper management and communication would require further efforts; on the other hand, a lot still needs to be clarified about chemical/toxicological hazards and, in particular, on the measures that can be taken in order to prevent them or reduce the probability of their occurrence.

The purpose of this opinion paper is to present an overview of chemical/toxicological risks of street cookery (to be considered as the activity of preparing and cooking foods exclusively on the street) in order to: identify the main chemical hazards for foods and characterize the toxicological risks for the general population. Starting from the intrinsic vulnerability of the food matrices to different chemicals, points of particular attention are considered -from the location through the handling, storage, processing and sale of meals- in order to produce recommendations addressed to the food vendors, thus protecting the healthy value of their goods.

1 STREET FOODS: AN EMERGING HOT ISSUE FOR HEALTH?

Street foods are defined by FAO/WHO Codex Alimentarius Commission as ready-to-eat foods prepared and/or sold by vendors and hawkers especially in the streets and other public places (FAO, 1989). This definition includes a wide range of ingredients and products, as well as raw materials and methods of preparation which often reveal traditional local cultures and recipes and include a large variety of meals, snacks and drinks (WHO/FAO, 2010).

There is growing awareness that street-vended foods (or “street foods”) represent an indispensable component of the modern food supply system as well as an important global issue worldwide (FAO, 1991; FAO, 1997; FAO/WHO, 2003; Nago, 2005; Chukuezi, 2010). The increasing spread of the phenomenon throughout the world, but mainly in developing countries, is the evidence of the rapid urbanization process and the changed patterns of living and eating (FAO, 2000; Johnson *et al.*, 2000). In many cities of developing world, indeed, the vending of street food significantly contributes to the food security of people who rely on

their daily and widespread availability.

In fact, due to their easy accessibility and diversified supply of meals, street foods represent an inexpensive and accessible means for low income communities of meeting their basic nutritional needs: it is estimated that the recommended daily energy intake can be met by consuming around US\$1 of street foods (FAO, 1991). In Africa, for instance, street alimentation enables 80% of urban populations to feed themselves easily and at lower prices and represents around 40% of their food budget expenditure (IFPRI, 2000).

Nevertheless, despite the nutritional, social and economic benefits that may originate from it, the selling of street foods raises serious concerns for the health of urban population. The major concern is related to food safety, in particular due to biological agents and chemical substances in food products presented to the public. The way forward the management of food safety of street vended food cannot escape the assessment of raw materials and processing and the accurate identification of those factors more vulnerable to hazards.

>> *Street food, Chiara Frazzoli for NOODLES © Thailand, 2011.*



2 STREET FOOD AND HEALTH: NOT ONLY MICROBIOLOGICAL RISKS...

Over the years, the microbiological hazards have been deeply examined and a number of studies on the detection of foodborne bacterial pathogens in street vended foods have been performed (e.g., FAO, 1991; Muleta *et al.* 2001; Abdussalam *et al.* 1993; Mensah *et al.* 2002; Omemu *et al.* 2008; Von *et al.* 2006, Opeolu *et al.*, 2010). The findings of these studies clearly demonstrate the role of street foods in the transmission of pathogens like *Bacillus cereus*, *Staphylococcus aureus* and *Salmonella spp* and their short-term effects.

On the other hand, a lot still needs to be clarified about chemical/toxicological hazards and, in particular, on the magnitude of risks posed by them in the long term. Limited investigations and data on toxicological hazard of street foods exist, suggesting the probability of multiple contaminants of different origin presence in street food scenarios.

The scarcity of studies on chemical/toxicological hazards of street foods can be due to the fact that most effects of their exposition are “hidden”, i.e. not immediate (as those of microbiological hazards) but visible only in the long term and therefore often difficult to associate with past exposure. Therefore, chemical substances/toxicants can be considered “silent risk factors” for adverse health effects such as carcinogenic, teratogenic, mutagenic as well as endocrine effects. It is known that the effects on human health depend mainly on the exposure pattern and magnitude, the toxicity as well as the vulnerability and susceptibility of subject.

The long term exposure to chemical/toxicological haz-

ards of street foods raises further concerns because of the cumulative daily intake of a certain toxicant and the fact that vulnerable and most-at-risk populations, such as children and women of childbearing age, represent an important segment of street foods consumers. In Nigeria, for instance, 96% of the elementary school children buy breakfast from street food vendors and in Bangkok, children 4-6 years old got 80% of the energy, protein, fat and iron intake from street foods (FAO, 2000).

In this scenario, women (including those in childbearing age) account for the majority of street vendors in many countries: e.g. they are involved in 81% of street-food business in Zimbabwe, 90% in the Philippines, 53% in Senegal and 66.67% in Nigeria (Graffham *et al.*, 2005; Chukuezi, 2010). Mensah *et al.* (2002) observed that in Accra (Ghana), even though the majority of street food consumers are men, many mothers working at the markets in Accra also bought some food items from vendors to feed their babies and it is reasonable not to exclude that women-vendors consume the same meals they prepare and sell. The specific concern for women in childbearing age lays in long-term effects implicating health risk also for future generations. In fact, intrauterine exposure and first infancy requires, indeed, particular attention due to the vulnerability of the foetus and the likelihood for the developing organisms to trigger situations regulating the chances of developing future health outcomes such as endocrine and metabolic diseases (Frazzoli *et al.*, 2009).



>>> *Street food, Chiara Frazzoli for NOODLES © Thailand, 2011.*

3

CHEMICAL/TOXICOLOGICAL HAZARDS OF STREET COOKERY

Despite the fact that the term street-vended foods includes both the foods prepared on the street and ready to eat, as well as those prepared at home and consumed on the street without further preparation (FAO, 1989), this opinion examines foods exclusively prepared on the street as area deserving special attention for chemical/toxicological hazards as more prone to those risks.

Thus, NOODLES purpose is to focus on street cookery, intended as the activity of preparing and cooking food exclusively on the street.

The large collection of ingredients, methods of preparation and street cookeries are proportional to the number of risks to whom they are exposed: food is susceptible to contamination by chemical/toxicological hazards at various stages: from the preparation process to storage and sale of meals, and the following depicts the scenario.

Location

For profitable reasons, street food stalls are mainly placed in the most congested streets, close to crowded centers and manufacturing activities, at bus/train stations, etc. Food processing and displaying area is so exposed to several airborne toxicants, such as lead and other heavy metals, polycyclic aromatic hydrocarbons (PAHs) and persistent organic pollutants (POPs) such as dioxins and polychlorinated biphenyls (PCBs). Furthermore, the majority of the vending sites are poorly constructed, determining the lack of proper protection of foods from air pollution (Muinde *et al.*, 2005). A study conducted in Indonesia, for instance, reported the presence of heavy metals (e.g. iron and lead) in several food samples, linked, at least partly, to atmospheric pollution, especially from automobile exhaust fumes (Simopoulos *et al.*, 2000).

Poor sanitary conditions in the area where food is prepared and vended also contribute to high risks exposure of foods to toxicants: lack of services, such as potable water supplies, inadequate refuse disposal facilities and open burning of wastes expose foods to dangerous toxicants such as PAHs and dioxins. In Nairobi (Kenya) 92.5% of the street food processors did not have a waste disposal area and threw waste water close to the stalls, increasing the pollution of the soil and groundwater (Muinde *et al.*, 2005).

Raw materials

Source and quality of raw materials play a fundamental role in the safety of street foods. Contamination introduced by raw materials could be carried over through processing and cooking.

A critical raw material in street-vended operations is water. Water is present in many stages of food sale: it is used for drinking, as well as to wash foods, equipment, utensils and hands; it can also represent

an ingredient and be used in the processing of food, e.g., by boiling. Depending on the scenarios, water sources can be contaminated by industrial or domestic wastewater, pesticides or sewage; moreover, the frequent unavailability of potable water near the stalls and the consequent re-use of the water used for cleaning utensils and dishes is a major concern (FAO, 2009; Rane, 2011).

Moreover, in order to apply low prices, vendors may purchase cheap raw materials from unreliable sources and/or clandestine dealers. These raw materials are often substandard and present health hazards: for instance, spoiled materials, especially nuts, grains and related products, may be contaminated by mycotoxins, while foods of plant or animal origin may bear unauthorized residues, or illicit biocides (WHO, 1996, WHO/FAO, 2010). A safety study from Accra found that 70% of street food samples contained residues of the organophosphorous pesticide chlorpyrifos; while benzoic acid, tetradifon and aflatoxin have been reported in a survey of 74 samples of street food sold in Bangkok (Vatanasuchart *et al.*, 1994).

Finally, since organic and inorganic pollutants have different lipophilicity, different accumulation patterns are implicated in the level of toxicants of the meal, depending on the relevant composition of raw materials. Certain persistent lipophilic chemicals, such as polychlorinated biphenyls (PCBs) and DDTs can accumulate in the adipose tissue of animals, causing an increased likelihood of toxicants in edible tissues. For all this reasons, the selection of raw materials represents a major step in the safety of street foods.

Storage

The place where foods are stored is often not properly sheltered from contamination sources.

In most cases, foods are not covered and presences of liquid and solid wastes in the storage areas have been frequently reported (Rane, 2011) and the ill-aimed attempts at defending stored foods from pests may lead to an overenthusiastic use of biocides (organophosphorus insecticides, disinfectants such as formaldehyde, anticoagulant rodenticides, etc.), leading to contamination by residues.

Most important, inadequate storage conditions (such as temperature, moisture and prolonged time) and/or facilities promote the growth of mycotoxin producing fungi and the production of mycotoxins in numerous raw materials, mainly cereals, dry fruits, spices, coffee and cocoa. Contamination with aflatoxins has been reported in two surveys of street foods in Bangkok (Vatanasuchart, 1994; Dawson *et al.*, 1996), in 35% of the samples collected in Khatmandu (Nepal) and 17% of foods containing peanuts in Indonesia (Winarno, 1993).

As for chemical/toxicological risks food faces during the storage, big importance is given to the quality of utensils and equipment where foods are stored, as reviewed in the following sub-section.

Utensils and Equipment

The use of adequate utensils and equipment for the preparation and storage of food is critical to the safety of street vended foods. Inappropriate cookware, food containers and packaging and kitchen utensils used for and during the preparation, cooking and serving, as well as the storage of raw materials and prepared food, may determine food contamination with toxicants. Moreover, the combination of poor quality materials and improper practices may lead to the formation or leaching of toxic compounds, such as heavy metals, perfluorinated compounds (PFOS, PFOA) and bisphenol A.

An important risk factor for the equipment is the frequent purchase of pots and other utensils from informal manufacturers/retailers. This is obviously attributed to their inferior cost and the consequent lower economic loss that would occur when equipment would be confiscated by the police during a raid (in fact street food vending is still an informal sector). Interviews with vendors in Harare (Zimbabwe) and Accra showed the high frequency of using informally fabricated pots, often manufactured with poor quality materials, such as scrap metals from various sources: derelict cars, car batteries or industrial machinery, that may leach a number of toxic metal compounds (Tomlins *et al.*, 2004; FAO/WHO, 2005). The study carried out in Accra reported a number of food samples with high levels of lead, cadmium, arsenic, mercury and copper, suggesting a probable leaching from the utensils (Tomlins *et al.*, 2004).

Besides metals, utensils and equipment may release also other contaminants, especially at high temperature and/or in contact with acidic or fat foods. Melamine and formaldehyde, for instance, may be released by utensils or plates made of melamine resin if exposed to high temperature, e.g. when frying (BfR, 2011). Perfluorinated compounds might be released by the Teflon or non-stick coatings when deteriorate or at temperature above 230°C. Leaching of DEHP (Bis(2-ethylhexyl)phthalate) from polyvinylchloride (PVC) may occur upon prolonged contact with fat foods, such as dairy products. Finally, bisphenol A, an additive of polycarbonate plastic containers (e.g. baby bottles and plastic containers) may be released upon prolonged use and/or when in contact with hot liquids.

Food processing and cooking practices

Preparation and processing of street foods should be done adequately in order to reduce chemical/toxicological hazards in the final food product. Food processing and cooking practices can involve boiling, frying, baking and grilling. Particular attention should be given to overcooking, grilling and/or excessive reuse of cooking oils for frying because of the possible production of carcinogenic chemicals.

Formation of PAH, a group of different carcinogenic and genotoxic chemicals, for instance, may occur during the grilling or smoking of meat as well as from overbaking at high temperature of dough-based foods (Ruchirawat *et al.*, 2005). Acrylamides, another carcinogenic and genotoxic substance is generated in fried or overheated carbohydrate foods, especially if cooked at temperature higher than 120°C. In his study carried out in Owerri (Nigeria), Chukuezi (2010) found that 72.42% of street food vendors reused oil for frying several times, determining a probable production of cancer-causing chemicals, such as PAHs and acrylamide.

Use of banned or hazardous (for toxicity and excess amount) food additives, such as coloring agents, is another diffused chemical hazard to be considered in street food. Johnson *et al.*, (2000) in their study in Accra, reported that many vendors add some coloring agents during the preparation of waakye (a popular Ghanaian food) to give it a characteristic color. Presence of banned or hazardous coloring agents, like Metanil yellow, Orange II and Rhodamine B has been detected in India (Simopoulos, 2000), while in West Java (Indonesia) non-food-grade additives, such as textile coloring agent, were detected in several street food preparations as well as soft drinks (IPB, 1990).

On the other hand, adequate food processing may improve the quality of food by reducing the presence of such hazards, as anti-nutritional factors: substances endogenously present in several foods (mainly cereals) able to reduce the bioavailability of minerals and digestibility of proteins. Anti-nutritional factors in foods can be, indeed, reduced by adequate processing and, consequently, bioavailability of nutrients will increase: e.g., the augmented bioavailability of iron and zinc and the digestibility of proteins in sorghum after adequate fermentation (Wisal *et al.*, 2005; Ibrahim *et al.*, 2005; Mohammed *et al.*, 2010).

Cleaning practices

Finally, the excessive use or misuse of insecticides and cleaning agents in the stalls may determine the laying down of chemicals on the surface of displayed meals or contaminate the soil or the ground water. Cleaning products may present, indeed, several health and environmental concerns. They may contain chemicals classified as hazardous for human health as well as toxic for aquatic species in polluted waters.

Weather and environmental conditions of street food stalls in developing countries may entrain a high presence of insects, which are potential vectors of microbiological contamination. Thus, there is no doubt that measures should be taken to reduce the insect presence; however, an inaccurate and exceedingly eager use may be hazardous itself. Neurotoxic insecticides such as organophosphorates, carbamates and pyrethroids are typical examples of biocides with direct toxicity. Organochlorine insecticides are stable compounds persisting in the environment for prolonged periods and can be accumulated in the body's adipose tissue with long term effects on liver and on the central nervous, endocrine and reproductive systems.

Most organochlorine insecticides have been banned in industrialized Countries and many developing Countries since decades (DDT since 1970's under the Stockholm Convention). However, household uses

may still be common in scenarios such as street food vending, due to the lack of proper regulations and/or controls and the low cost of “dumped” pesticide stores (Johnson *et al.*, 2000; Abaidoo, 2009).

4 A NEEDED STEP FORWARD

Even the fact that is an important source of affordable food, street foods sector has still not being officially recognized in many countries and, consequently, it does not meet adequate standards neither there is public awareness of risks posed. The reasons are several and may differ according to the countries; these include inadequate regulatory laws and systems, lack of infrastructures and financial resources to invest in safer equipment and lack of education for street food vendors.

All such reasons may reflect an understatement of street food role for food security as well as for economic and social welfare of urban communities.

Nevertheless, since street food vending has become increasingly important as urban phenomenon, it would be necessary to take different measures in order to prevent all sort of hazards, including the chemical/toxicological ones and/or reduce the probability of their occurrence in foods. Different preventive measures have been proposed and, occasionally, put in place. Among them, HACCP (Hazard Analysis and Critical Control

Point) is the main reference model: a preventive proactive approach which allows identifying potential risk factors before they occur. Nonetheless, HACCP strategy is exclusively focus on hygienic/microbiological risks and do not take into account the chemical/toxicological risks. Consequently, there is the necessity of a systematic and comprehensive extension of HACCP approach to factors associated with chemical/toxicological hazards. Since the introduction of chemical/toxicological hazards to HACCP model has not yet been explored, it is a field study that requires be carrying out and deeply investigating. The adaptation of HACCP model to natural and man-made chemical hazards is a study field at its starting stage that requires being carried out and thoroughly investigated.

The reduction of both microbiological and chemical/toxicological in street cookery, indeed, would allow improving the quality of foods, reducing the occurrence of short and long term foodborne illness, thus enhancing the health and social benefits from the street food sector.

REFERENCES

- Abdussalam M. and Kaferstein F.K. (1993). Safety of street foods. *World Hlth. Forum*, 14:191-194.
- BfR (Federal Institute for Risk Assessment) (2011). Release of melamine and formaldehyde from dishes and kitchen utensils. Opinion Nr. 012/2011, 09 March 2011.
- Chukuezi C.O. (2010). Food Safety and Hygienic Practices of Street Food Vendors in Owerri, Nigeria. *Studies in Sociology of Science*, 1:50-57.
- Dawson R., Liamransi S. and Boccas F. (1996). Bangkok's Street Food Project. Food, Nutrition and Agriculture / Alimentation Nutrition and Agriculture. *FAO Publication 17/18*.
- FAO (1989). Street foods. Report of an FAO Expert Consultation, Jogjakarta, Indonesia, 5-9 December 1988. *FAO Food Nutr. Pap.*, 46:1-96.
- FAO (1991). Street foods in developing countries: lessons from Asia. Food, Nutrition and Agriculture - 1 - *Food for the Future*. FAO. Rome
- FAO (1997). Street food. Food, Nutrition and Agriculture – 63. *Report of an FAO Technical Meeting on Street Foods*, Calcutta, India 6-9 November 1995
- FAO (2000). FAO Technical Support for Improvement within the Street Food sector. GAUTENG PROVINCE, Pretoria.
- FAO (2009). Good hygienic practices in the preparation and sale of street food in Africa- Tools for training. Rome, FAO.
- FAO/WH (2003). Assuring Food Safety and Quality: Guidelines For Strengthening National Food Control Systems. *Food and Nutrition Paper n°76*. Rome, FAO.
- FAO/WHO (2005). Informal food distribution sector in Africa. FAO/WHO Regional Conference on Food Safety for Africa. Harare, Zimbabwe, 3-6 October 2005.
- Frazzoli C., Petrini C. and Mantovani A. (2009). Sustainable development and next generation's health: a long-term perspective about the consequences of today's activities for food safety. *Annali dell'Istituto Superiore di Sanità*, 45(1):65-75.
- Graffham A., Zulu R. and Chibanda D. (2005). Improving the safety of street vended foods in Southern Africa. *Final Report*, CPHP project R8272.
- Ibrahim F.S., Babiker E.E., Nabila E.Y., Abdullahi H. and ELTinay (2005). Effect of fermentation on biochemical and sensory characteristics of sorghum flour supplemented with whey protein. *Food Chem.*, 92:285-292.
- IFPRI (2000). Urban Livelihoods and Food and Nutrition Security in Greater Accra, Ghana. Report 112. International Food Policy Research Institute. Washington, USA.
- IPB, TNO, VU, 1990. Consumption of street foods: Total-diet studies among students in Bogor. *Streetfood Project Working Report* no. 3. Jakarta and The Hague: BPPT and DGIS, Food Technology Development Center (Bogor Agricultural University, Indonesia).
- Johnson P.N.T. and Yawson R.M. (2000). Enhancing the food security of the peri-urban and urban poor through improvements to the quality, safety and economics of street-vended foods. *Proceedings of workshop for stakeholders, policy makers and regulators of street-food vending in Accra*, at Miklin Hotel, Accra, 25 –26th September, 2000. DFID/NRI/FRI Crop Post Harvest Program Project.
- Mensah P., Yeboah-Manu D., Owusu-Darko K. and Ablordey A. (2002). Street foods in Accra, Ghana: how safe are they? *Bulletin of the World Health Organization* 80(7): p546-554.
- Mohammed N.A., Isam A.M.A. and Babiker E.E. (2010). Nutritional Evaluation of Sorghum Flour (Sorghum bicolor L. Moench) During Processing of Injera. *International Journal of Biological and Life Sciences*, 6:1.

- Muinde O.K. and Kuria E. (2005). Hygienic and sanitary practices of vendors of street foods in Nairobi, Kenya. *AJFAND*, 5: 1-13. Available at www.ajfand.net
- Muleta D. and Ashenafi M. (2001). Salmonella, Shigella and Growth potential of other food-bourne pathogens in Ethiopian street vended foods. *East African Medical Journal*, 78:576-580.
- Nago C. (2005). Experiences on street foods in West Africa. Paper presented at an FAO/Consumers International workshop on street-vended foods in Eastern and Southern Africa: Balancing safety and livelihood, 15-17 June, 2005. Lilongwe, Malawi.
- Omemu A.M. and Aderoju S.T. (2008). Food safety knowledge and practices of street food vendors in the city of Abeokuta, Nigeria. *Food control*, 19:396-402.
- Opeolu B.O., Adebayo K., Okuneye P.A. and Badru F.A. (2010). Physicochemical and Microbial Assessment of Roadside Food and Water Samples in Lagos and Environs. *J. Appl. Sci. Environ. Manage*, 14(1) 29 – 34.
- Rane S. (2011). Street Vended Food in Developing World: Hazard Analyses. *Indian J Microbiol.*, 51(1): 100–106.
- Ruchirawat M., Navasumrit P., Settachan D., Tuntaviroon J., Buthbumrung N. and Sharma S. (2005). Measurement of genotoxic air pollutant exposures in street vendors and school children in and near Bangkok. *Toxicol. Appl. Pharmacol*, 206(2):207-14.
- Simopoulos A.P. and Bhat R.V. (2000). Street foods. *World Rev Nutr Diet. Basel, Karger*, 2000, 86:53–99.
- Tomlins K., Johnson P.N. (2004). Developing food safety strategies and procedures through reduction of food hazards in street-vended foods to improve food security for consumers, street food vendors and input suppliers. Crop Post Harvest Programme (CPHP) Project R8270. Funded by the DFID.
- Vatanasuchart N. and Hutabarat L.S.R. (1994). Chemical contaminants in street food. *Univ. Annual Conference, Bangkok (Thailand)*, 3-5 Feb 1994.
- Von H.A. and Makhoane F.M. (2006). Improving street food vending in South Africa: Achievements and lessons learned. *International Journal of Food Microbiology*, 111: 89-92.
- WHO, 1996. Essential safety requirements for street-vended foods. World Health Organization, Switzerland.
- WHO/FAO (2010). Basic steps to improve safety of street-vended food. Safety of street-vended food. International Food Safety Authorities Network - *INFOSAN Information Note No. 3/2010*.
- Winarno F.G. (1993). Street foods in developing countries: Lessons from Asia. Abstracts-Final Programme Street Foods Epidemiology, Management and Practical Approaces, Beijing, Oct 19-21, 1993, pp 2-3.
- Wisal I.H., AbdelRahman S.M., ELMaki H.B., Babiker E.E. and EL Tinay A.H. (2005). Effect of germination, fermentation and cooking on phytic acid and tannin contents and HCl extractability of minerals of sorghum (*Sorghum bicolor*) cultivars. *J. Food Technol.*, 3 (3):410-416.