Chemical food contaminants are substances that have been unintentionally added to food. Some chemical food contaminants are formed naturally (for example mycotoxins), while others come from environmental contamination (for example heavy metals, dioxins, polychlorinated biphenyls [PCBs], radionuclides), or are created during food processing (for example acrylamide).

Exposure to chemical food contaminants is associated with a wide range of adverse health effects. For example, chronic exposure to mycotoxins may cause cancer, endocrine disruption, gastrointestinal disorders, and kidney function disorders. Exposure to polycyclic aromatic hydrocarbons (PAHs) may result in adverse effects on the liver, reproduction and development, and the immune system\(^1\). Some PAHs are carcinogens - benzo[\(\alpha\)]pyrene is classified as carcinogenic in humans (Group 1)\(^2\). Heavy metals, such as mercury, cadmium, arsenic, and lead, are associated with cognitive developmental delays in children and neurological impairment in adults, as well as with adverse effects on the immune and cardiovascular systems.

This chapter addresses chemical food contaminants. Chemicals in food linked with wastewater irrigation are addressed in the Wastewater chapter, pesticide residues are addressed in the Pesticides chapter, and food contact materials are addressed in the Chemicals in Consumer Products chapter.
Policy and Regulations

The new Public Health Protection (Food) Law, enacted in 2015, prohibits the production, import, or sale of food containing contaminants at levels exceeding the maximum levels (MLs) specified in the regulations. MLs are generally established to protect vulnerable populations, including children.

The National Food Service (NFS) at the Ministry of Health (MoH) regulates food contaminants, including mycotoxins, dioxins, PCBs, heavy metals (lead, cadmium, mercury, and arsenic) and PAHs(6). In January 2017, the NFS updated the guidelines and defined the MLs of heavy metals. The new guidelines include a range of food categories and stricter MLs. The NFS also updated the guidelines for the MLs of PAHs and melamine in infant formula and in other food items, and published a new directive on the MLs of dioxins, furans, and PCBs. In addition, the standards related to mycotoxins are being updated. In 2016, the NFS published a consumer health advisory on arsenic in rice and in rice products with the recommendation that infants and pregnant women consume a variety of cereals and avoid consuming rice as the main cereal(7).

The NFS has a number of routine monitoring programs, including the monitoring of pesticides and mycotoxins. It also conducts surveys as needed, based on assessments of existing and emerging hazards that might not be covered by routine monitoring - for example, mercury in fish, arsenic in rice and rice products, dioxins, furans, and PCBs in food of animal origin, and PAHs in smoked food.

The Veterinary Services unit at the Ministry of Agriculture and Rural Development (MoAg) conducts annual surveys on heavy metals, pesticides, pharmaceuticals, and other contaminants in food of animal origin, such as eggs, beef, turkey, and chicken.

Data on Contaminants in Food in Israel

Mycotoxins
The NFS monitors mycotoxins in food products marketed in Israel. The monitoring is carried out according to an annual sampling plan that targets products known to be at high risk of containing mycotoxins such as corn, nuts, dried fruits, cereals, and dairy products.

In 2014, 535 food samples were collected and 925 tests were conducted to detect and quantify aflatoxins (types AFB1, AFM1, and total aflatoxins) and ochratoxin. Three out of the 535 samples (0.56%) exceeded the MLs(5). In 2015, the NFS tested for the presence of mycotoxins in 470 samples (mostly nuts, spices, dry fruits, and milk). No mycotoxins were detected in 42% of the samples, and four (0.85%) samples had AFB1 levels above the MLs (Figure 1)(9).
Distribution of Mycotoxin Monitoring Results in Israel, 2015

Polycyclic Aromatic Hydrocarbons (PAHs)
In 2015, the NFS tested 132 food samples for the presence of PAHs. These included smoked and other meat products, smoked fish, extracts used in the smoking process, cocoa products, infant formula, and vegetable oils. The full list of the 16 compounds tested is available in the MoH report(4).

In 60 samples (45.45%), all 16 compounds (PAH16) were found to be below the level of detection (LOD). Figure 2 shows the percentage of samples with levels above the LOD for PAH4 (benzo[α]pyrene, benzo[b]fluoranthene, chrysene, benz[α]anthracene) and PAH16, according to food categories. Out of 132 food samples, only one product exceeded the ML for PAH4(4).

Percent of Samples above the Level of Detection, by Food Categories in the National Food Service Survey, 2015

Legend: 
- Exceedances
- Below maximum level
- Below level of quantification
Based on these data, the NFS conducted a risk assessment to estimate exposure and risk for average and heavy consumers of the food categories sampled, using food consumption data from the National Health and Nutrition Surveys (MABAT). This assessment indicated that there is negligible concern for public health from exposure to PAHs from foods in the categories tested in this survey.

**Heavy Metals**

Data on concentrations of mercury in imported fish is collected regularly by the NFS. The NFS is also conducting a survey on arsenic in rice products, and the data will be published in 2017-2018.

**Residues in Animal Products**

The annual survey published by the MoAg’s Veterinary Services and Animal Health Unit for 2014/2015 includes data on residues of heavy metals, pesticides, and pharmaceuticals in locally produced food of animal origin. Of the beef samples tested in 2015, none contained arsenic or lead. Organochlorine pesticides were detected in 10 beef samples (5.1%) at concentrations below the ML, and cadmium was detected in 6 beef samples (2.9%) at concentrations below the ML. Cadmium was detected in 170 turkey samples (76.2%) and in 21 chicken samples (7.5%); two of the turkey samples were above the ML. Organochlorine pesticides, PCBs, and heavy metals (other than cadmium) were not detected in turkey, chicken, or eggs. After finding high dioxin levels in four samples of eggs in 2013, the NFS and the MoAg have continued analyzing dioxin levels in eggs. None of the eggs sampled in 2014-2016 had dioxin levels above the ML of 5 pg/g fat. It should be noted that the ML in Israel is based on the European ML for dioxins in eggs.

**Progress Since 2014**

In *Environmental Health in Israel 2014*, the major challenges concerning chemical food contaminants included conducting surveys on the presence of phthalates, aluminum, and PAHs, and evaluating the levels of heavy metals and radiation in crops treated with coal ash.

The results of the NFS survey on PAHs in food were published in 2017. The NFS collected over 100 food samples for a 2016 survey on the presence of aluminum. The results are still being analyzed, and the report summarizing the results is expected in early 2018.

Some progress has been made in evaluating the levels of heavy metals and radionuclides in crops treated with coal ash. Little progress has been made in conducting a survey on phthalates.

**Major Challenges**

Accurate exposure assessment is an integral part of risk assessment. In its risk assessment of PAHs, the NFS used food consumption data (as opposed to market-based data) for the first time to assess dietary exposure. Food consumption data from the National Health and Nutrition Survey...
2015-2016 (Rav-MABAT), conducted among children and adults, is not yet available for use in risk assessment. The MoH plans to use data from this survey for exposure assessment, including for sub-populations. Creating a database of food consumption based on periodic National Health and Nutrition Surveys will enable more accurate exposure assessments for the general population and for sub-populations such as children, pregnant women, and vegetarians.

Public exposure to contaminants can be measured and quantified using a Total Diet Study (TDS). A TDS will enable a real assessment of the public’s exposure to a wide range of contaminants via food, taking into consideration the effect of the preparation process on the type and level of contaminants in food. The establishment of a TDS in Israel will be an important element in the MoH’s capacity to assess the public’s dietary exposure to food contaminants. This includes contaminants not previously measured, such as flame retardants and phenols.

Data from the Israel Oceanographic and Limnological Research Institute indicate an increase in mercury concentrations in fish in the Acre Bay, apparently as the result of ongoing pollution from an abandoned plant on the shore. Due to the division of responsibility between the MoH and the MoAg, no ban has been imposed on fishing in the bay and a public advisory has yet to be issued.

References


