

• Pesticides:

- Pesticides are used to protect crops against insects, weeds, fungi and other pests. Pesticides play a significant role in food production. They protect or increase yields and the number of times per year a crop can be grown on the same land. This is particularly important in countries that face food shortages.
- Pesticides are potentially toxic to humans and can have both acute and chronic health effects, depending on the quantity and ways in which a person is exposed.
- Some of the older, cheaper pesticides can remain for years in soil and water. These chemicals have been banned (e.g. Organochlorines) from agricultural use in developed countries, but they are still used in many developing countries.
- The term of pesticide covers a very large group. Major ones and their effectivenesses:
- Insecticides (against insects)), herbicides (weeds), fungicides (fungi and moulds), Rhodenticides (rodents), repellants(insects, house hold use).
- Among them, insecticides are common in use

- **Hazards of pesticides**

1. The pesticide industries cause pollution of soil, water and air. The pesticidal residue washed along with rain water, is added to the nearby water resources making it unfit for drinking.
 2. They enter the food chain and cause problem of bioaccumulation or biomagnification.
 3. They are not target specific hence also kills non-pest insects. It adversely affect the mechanism of entomophily.
 4. Continuous and indiscriminate use of pesticides may develop resistance in insect pest like superpest and superbugs.
 5. They are non-biodegradable and affect the balance of ecosystem.
 6. They are highly toxic in nature and if not handled carefully, they can cause serious health problems like cancer, deformities and disease.
 7. Accidents in pesticides manufacturing units cause great loss of human life
- Therefore, as in many others, Turkey strictly controls the use of pesticides by legal regulations. Very detailed studies are needed to get permission for use a new pesticide.

- **Two main criteria are considered before giving permission:**

Toxicity against human, animals, environment

Maximum Residue Level (MRL) in food as mg/kg

- **HCA**s are the products of the pyrolysis of triptophane, glutamic acid, phenyl alanine and lysin. They lead to formation of heterocyclic mutagenes such as kinon and kinosalin in protein rich foods heated to more than 200°C.
- Grilling and pan frying generate more HCA compared to deep frying. When temperature is reduced to less than 150°C, the formation is also efficiently lowered.
- HCAs are metabolized very quickly and spread to the organs. Roasted beef contains considerably amount of HCA, compared to boiled meat. Microwave heating for 2 min before roasting reduced HCA formation by 90%.
- Major HCAs are below:
(IARC **Grup 2A, 2B**)

Chemical Name	Abrevation
2-Amino-3methylimidazo[4,5-f]quinoline	IQ
2-Amino-3,4-dimethylimidazo[4,5-f]quinoline	MeIQ
2-Amino-3,8-dimethylimidazo[4,5-f]quinoxaline	MeIQx
2-Amino-1-methyl-6-phenylimiazo[4,5-b]pyridine	PhIP

Acrylamide

- In April 2002 scientists in Sweden found Acrylamide in starchy foods, such as potato chips (potato crisps), French fries, and bread that had been heated higher than 120 °C, (production of acrylamide in the heating process was shown to be temperature-dependent). It was not found in food that had been boiled or in foods that were not heated.
- The main chemical process that causes this is known as the Maillard Reaction; it is the same reaction that 'browns' food and affects its taste.
- Acrylamide forms from sugars and amino acids (mainly one called asparagine) that are naturally present in many foods. Acrylamide also forms from glycerides and glycerol.
- Browned crispy crusts in foods like French fries, potato chips, crackers, pretzel-like snacks, cereals, and browned breads tend to have the highest levels of acrylamide.
- Known neurotoxicant (IARC 2002; Manson et al. 2005). US EPA has classified Acrylamide as a B2 carcinogen (probable human carcinogen)
- Maximum Allowable Dose Level (MADL) is 0.3-0.8 micrograms per kg body weight per day (Office of Environmental Health Hazard Assessment)
- No legal limit yet

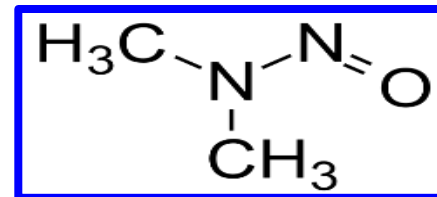
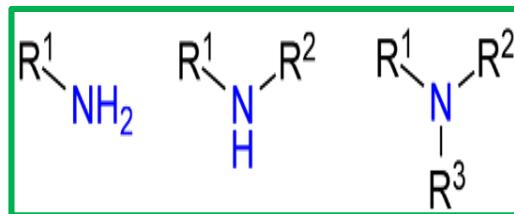


• **Packaging Contaminants:**

- Use of packages for foods is permitted after a long term study. Sometimes, migrations of some compounds from packages to foods are possible.
- **Bisphenol A (BPA)** is an industrial compound used extensively to produce synthetic polymers, such as epoxy resins, which are incorporated into the inner coating of metal cans, and also to manufacture polycarbonates (PC) with applications in bottles, including bottles of water and baby bottles. Several studies have reported on the transfer of this compound to food at high temperature, acidic or basic conditions and from damaged surfaces. BPA is considered an endocrine disruptor and several studies have proposed a relationship between exposure to BPA and the appearance of adverse health effects, such as cancer, infertility, diabetes, and obesity. In 2015 however, the European Food Safety Authority concluded in its last scientific opinion that this compound does not pose any risk to the exposed population's health. Therefore, the EU regards BPA as an authorized product to be used as food contact material. Although BPA intake through food is apparently below the set limits, research into BPA and its potential negative effects is still ongoing.
- PCs contain BPA however, single use PETs do not.
- **Diethylhexyl phthalate (DEHP)** belongs to a family of chemicals called phthalates, which was widely used in the past, as a plasticizer in manufacturing of some plastics such as PVC, due to its suitable properties and low cost. Its use has decreased in recent years, instead, some others obtained from vegetable sources have been used. Animal studies showed that it has toxic effects on fertility, however, there is no study for humans.

• N- Nitrosamines

- Nitrosamines have no known industrial use. However, they can be found in processed foods as unintentional by-products of food preparation and processing. Nitrosamines are formed by a reaction between nitrates or nitrites and certain amines. Nitrosamines and/or their precursors can be found in diverse consumer products such as processed meats, alcoholic beverages, cosmetics, and cigarette smoke. Nitrosamines can also be formed in the mouth or stomach if the food contains nitrosamine precursors. Under acidic pH in the mouth or stomach, nitrite or nitrates added to food or naturally occurring may combine with amines to form nitrosamines. The predominant nitrosamine formed is *N*-nitrosodimethylamine (NDMA) (Listed as 2A by IARC, probably carcinogen). Nitrosamines are considered to be strong carcinogens that may produce cancer in diverse organs and tissues including lung, brain, liver, kidney, bladder, stomach, esophagus, and nasal sinus.,
- Nitrosamines are formed in cured meats because nitrite, and sometimes nitrate, are added to these products during processing to prevent toxin formation by *Clostridium botulinum*. Nitrate is reduced to nitrite by the enzyme nitrate reductase, which occurs in a number of bacteria. Nitrite is converted to nitrosating agents which subsequently react with amines in the meat during processing, storage, and cooking to form nitrosamines.
- PRIMARY, SECONDARY AND TERTIARY AMINS
- Amines can be classified according to the nature and number of substituents on nitrogen. Primary amines arise when one of three hydrogen atoms in ammonia is replaced by an alkyl or aromatic group. Secondary amines have two organic substituents (alkyl, aryl or both) bound to the nitrogen together with one hydrogen. In tertiary amines, nitrogen has three organic substituents.



NDMA