

CHEMICALS AS CARCINOGENS AND CANCER IN HIMACHAL PRADESH

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Introduction

There are many risk factors for cancer: age, family history, viruses and bacteria, lifestyle (behaviors), and harmful substances.

More than 100,000 chemicals are used by Americans, and about 1,000 new chemicals are introduced each year. These chemicals are found in everyday items, such as foods, personal products, packaging, prescription drugs, and household and lawn care products. While some chemicals can be harmful, not all contact with chemicals is dangerous to your health. Substances known to cause cancer are called carcinogens. An early link between cancer and a chemical was found in the late 1700s. An English physician noted that a large number of chimney sweeps had cancer of the scrotum due to exposure to soot, which contains chemicals known as polycyclic aromatic hydrocarbons. Since then, many more chemicals have been identified as known or suspected causes

of cancer. Examples of Known Human Carcinogens • Asbestos • Arsenic • Benzene • Beryllium • Vinyl chloride .Examples of Possible Human Carcinogens • Chloroform • DDT

People are exposed to trace amounts of many chemicals every day. These everyday exposures are usually too small to cause health problems. Exposure to chemicals in the outdoors, at home, and at work may add to your chances of getting cancer. Certain chemicals, including benzene, beryllium, asbestos, vinyl chloride, and arsenic are known human carcinogens, meaning they have been found to cause cancer in humans. A person's risk of developing cancer depends on how much, how long, how often, and when they are exposed to these chemicals.

to human cancer (Doll Peto, 1981; Hoggins one and Muir, 1979).

HETEROCYCLIC AMINES: It was found that broiled dried fish had mutagenic activity. At present 7 out of 16 pyrolysis products have been demonstrated to be strongly carcinogenic. These seven carcinogenic chemicals are (6):

1. A alpha C = 2-Amino-9H pyrdo (2,3-b)-indole
2. Glu-P-1 = 2-Amino-6-methyl dipyrido-imidazole
3. Glu-P-2 = 2-Aminodipyrido-imidazole
4. IQ = 2-Amino-3-methylimidazo-quinoline
5. Me A alpha C = 2-Amino-3-methyl-9H-Pyrido-indole
6. Trp-P-1 = 3-Amino-1,4-dimethyl-5H-pyrido-indole

Scientific studies, particularly epidemiological studies have shown that food and life-styles are closely related

3 Cancers Associated with Various Occupations or Occupational Exposure

Cancer	Substances or Processes
Lung	Arsenic, asbestos, cadmium, coke oven fumes, chromium compounds, coal gasification, nickel refining, foundry substances, radon, soot, tars, oils, silica
Nasal cavity and sinuses	Formaldehyde, isopropyl alcohol manufacture, mustard gas, nickel refining, leather dust, wood dust
Larynx	Asbestos, isopropyl alcohol, mustard gas
Pharynx	Formaldehyde, mustard gas
Lymphatic and hematopoietic	Benzene, ethylene oxide, herbicides, x-radiation system
Liver	Arsenic, vinyl chloride
Lip	Sunlight
Bladder	Aluminum production, rubber industry, leather industry, 4-aminobiphenyl, benzdine
Mesothelioma	Asbestos
Skin	Arsenic, coal tars, mineral oils, sunlight
Soft-tissue sarcoma	Chlorophenols, chlorophenoxy herbicides

7. Trp-P-2 = 3-Amino-1-methyl-5H-pyrido-indole

They induced hepatocellular carcinomas in the livers and tumors in some other organs such as small intestine, colon, brain, skin, oral cavity, lung, clitoral gland, etc. All these heterocyclic amines are quickly degraded and they also lost mutagenic activity on treatment with hypochlorite, which is usually present in chlorinated tap water. It is also found that fresh juices from vegetables and fruits, such as cabbage, broccoli, green pepper, egg plant, apple, burdock, stone-leek, ginger, mint leaf, and pineapple can inactivate the mutagenicities of tryptophan pyrolysis products. In extracts of leaves of cabbage a chemical is identified to be a peroxidase which inactivated Trp-P-1 and Trp-P-2. Table 1 shows the amounts of heterocyclic amines in cooked foods.

Polycyclic Aromatic Hydrocarbons (PAH):

The presence of polycyclic aromatic hydrocarbons (PAH) as carcinogens in foods has been known since 1950s. These chemicals have also been found in uncooked vegetables, fruits, cereals, and vegetable oils. The amount of polycyclic hydrocarbons present in cooked foods depends on the time of cooking, the distance of materials from the heat source, whether the melted fat is allowed to drop into

the heat source, etc., At least 18 mutagenic and/or carcinogenic polycyclic aromatic hydrocarbons are known at present and these are shown in Table 2.

In vegetables, fruits, and cereals, the amounts of these chemicals depend on the degrees of industrial and traffic pollutants in the areas in which they are grown. The amounts of carcinogenic polycyclic aromatic hydrocarbons in foods vary from 0 to 400 micrograms/kilogram.

12 of the 18 polycyclic aromatic hydrocarbons that were detected in broiled meat or smoked fish are known to be carcinogens. These 12 are shown in Table 2, and are classified as **Strong Carcinogens, Moderate Carcinogens, and Weak Carcinogens.**

Strong Carcinogens:

1. Benz (a) anthracene
2. Benzo (a) pyrene
3. Benzo (b) fluoranthene
4. Benzo (j) fluoranthene
5. Dibenz (a, h) anthrene
6. 2-methylchrysene
7. 3-methylchrysene

Moderate Carcinogens

8. Benzo (e) pyrene
9. Chrysene
10. Indeno (1,2,3-cd) pyrene

Weak Carcinogens

11. Anthanthrene

12. Benzo (b) chrysene

Available data are not sufficient to determine the carcinogenicities of benzo (g, h, i) perylene, coronene, perylene, and phenanthrene. There is no evidence to prove the carcinogenicity of fluoranthrene and pyrene per se in experimental animals. Carcinogens in cooked food, fungal products, plant and mushroom substance, and nitrite-related materials, polycyclic aromatic hydrocarbons and oxidative agents, heterocyclic amines (HCAs) to which humans are continuously exposed in an ordinary lifestyle. The series of heterocyclic amines can be divided into two groups: the 2-amino-3-methylimidazo[4,5-f]quinoline (IQ)-type heterocyclic amines and non-IQ-type heterocyclic amines. IQ-type heterocyclic amines have a 2-aminoimidazole moiety as a common

structure and are formed by heating mixtures of creatine, amino acids, and sugars. Non-IQ-type heterocyclic amines contain a 2-aminopyridine moiety as a common structure and are produced by heating amino acids such as L-tryptophan and L-glutamic acid. In routinely cooked meat and fish, the former type of heterocyclic amines, amino imidazoquinolines, amino imidazoquinoxalines, and amino imidazopyridines account for the major portion of the mutagenicity. The coexistence of many other mutagens/carcinogens of either autobiotic or xenobiotic type and the possibility that HCAs induce genomic instability and heightened sensitivity to tumor promoters suggest that avoidance of exposure to HCAs or reduction of HCAs' biological effects as far as possible are to be highly recommended.

Table 1. Amounts of heterocyclic amines in cooked foods (ug/kg) (6)

Food (microgram/kilogram)	Amounts of Heterocyclic amines
3. Grilled Chicken	15-180
4. Broiled Sun-dried cuttle fish	280
5. Grilled Chinese mushroom	5-47
6. Grilled Onion	1.5

Table 2. Amounts of Polycyclic Aromatic Hydrocarbons in Foods in ug/kg (6)

Name of Carcinogen	Types of Tumor and Cancers	Major food sources and amounts in (ug/kg)
STRONG CARCINOGENS		
1. Benz (a) anthracene	Lung adenoma, hepatoma, bladder carcinoma, skin papilloma, etc	Broiled or smoked meat (0.2-31) Smoked Fish (0.02-189) Vegetables (0.3-230) Vegetable oils (0.5-125)
2. Benzo (a) pyrene	Papilloma and carcinoma of forestomach, skin; leukemias, mammary carcinomas	Smoked meat (0.02-107) Vegetables (0.2-8) Vegetable oils (0.9-62)
3. Benzo (b) fluoranthene	Local sarcoma, skin (papilloma and carcinoma)	Broiled or smoked fish (0.1-37); smoked meat (0.4-15)
4. Benzo (j) fluoranthene	Lung carcinoma and skin (papilloma and carcinomas)	Smoked fish (0.5-23) Grilled sausages (0.2-15) Margarine (2.3 - 10.5)
5. Dibenz (a, h) anthracene	Fore stomach (papilloma and carcinoma)	Broiled meat (0.2) Vegetable oils & fats (0-4)
6. 2-Methylchrysene	Skin	Vegetables (0.9-6.2)
7. 3-Methylchrysene	Skin	Vegetables (1.7-20.2)
MODERATE CARCINOGENS		
8. Benzo (e) pyrene	Skin (papilloma and carcinoma)	Smoked fish (1.9-29) Broiled or smoked meat (0.1-27); vegetable oils (0.6-32)
9. Chrysene	Skin (papilloma and carcinoma), local sarcoma, hepatic tumor	Broiled meat (0.6-25) Smoked fish (0.3-173) Vegetables (5.7-395)
10. Indenol (1,2,3-cd) pyrene	Skin, local sarcoma	Broiled sausages (0.3-9) Margarine (0.2-5.5)
WEAK CARCINOGENS		
11. Anthanthrene	Skin, lung	Charcoal-broiled steak (2)
12. Benzo (b) chrysene	Initiating activity (skin papilloma)	Broiled meat (0.5)

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Vegetables (0.5-1.5)	Prostate and colon	10
Vegetables (0.5-1.5)	Prostate and colon	9
Vegetables (0.5-1.5)	Prostate and colon	8
Vegetables (0.5-1.5)	Prostate and colon	7
Vegetables (0.5-1.5)	Prostate and colon	6
Vegetables (0.5-1.5)	Prostate and colon	5
Vegetables (0.5-1.5)	Prostate and colon	4
Vegetables (0.5-1.5)	Prostate and colon	3
Vegetables (0.5-1.5)	Prostate and colon	2
Vegetables (0.5-1.5)	Prostate and colon	1

