*Voyager: Vol. VI, Dec. 2015, 164-173 : 2015*
*ISSN :0976-7436 : INDEXED AND ABSTRACTED*


# Carcinogenic Effects Of Common Chemicals On Health

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**Abstract**

*We are exposed to trace amounts of many chemicals every day. These everyday exposures are usually too small to cause health problems or we are unaware of their effects on our health. Some of these chemicals can be harmful substances causing cancer known as carcinogens. A cell becomes cancerous when it grows quickly and uncontrollably. In most cancers, this process leads to the growth of tumors. Brain tumors and leukemia are associated with exposures to chemicals. Examples of known human carcinogens are : Asbestos, Arsenic, Benzene, Beryllium & Vinyl chloride, chloroform & DDT etc. Exposure to indoor air pollution from combustion sources used for heating and cooking, as well as high levels of cooking oil vapors resulting from some cooking methods, may cause lung cancer. Chemicals known as Polycyclic aromatic hydrocarbons (PAH) & Heterocyclic hydrocarbons (HCA) are formed when muscle meat including beef, pork, fish, and poultry, is cooked using high-temperature methods, such as pan frying or grilling directly over an open flame. Polycyclic aromatic hydrocarbons (PAH) as carcinogens in foods have also been found in uncooked vegetables, fruits, cereals, and vegetable oils. In this paper an attempt has been made to provide knowledge about carcinogenic effects of chemicals on health for awareness and prevention.*

**Keywords:** *Chemicals, Carcinogens, Cancer, Polycyclic & Heterocyclic hydrocarbons.*

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**Introduction**

It is of great concern that our contact with some substances/ chemicals or exposures may deteriorate health and cause cancer. 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 and we are all exposed to cancer-causing chemicals despite our efforts to avoid them. While some chemicals can be harmful, not all contact with chemicals is dangerous to our health. Substances and exposures that can lead to cancer are called *carcinogens*. Many chemicals are identified as human mutagens and carcinogens (Fishbein and Maugh, 1977). A number of food additives, pesticides, insecticides and industrial chemicals have shown carcinogenic properties chemical exposure to occupation hazards or to drugs have caused human cancers (Doll and Peto, 1981; Weisburger, et al., 1982). An early link between cancer and a chemical was found in the late 1700s. Examples of known human Carcinogens • Asbestos • Arsenic • Benzene • Beryllium • Vinyl chloride. Chloroform • DDT. Carcinogens do not cause cancer in every case, all the time. Substances labeled as carcinogens may have different levels of cancer-causing potential. Some may cause cancer only after prolonged, high levels of exposure. Some carcinogens do not affect DNA directly, but lead to cancer in other ways. They may cause cells to divide at a faster than normal rate, which increase the chances of DNA changes. A person's risk of developing cancer depends on how much, how long, how often, and when one is exposed to these chemicals and general health. We are unaware of their effects on our health because these everyday exposures are usually too small to cause health problems. Chemical substances even in food items and everyday items may act as carcinogens. Carcinogens in cooked food, fungal products, plant and mushroom substance, and nitrite-related materials, polycyclic aromatic hydrocarbons, oxidative agents and heterocyclic amines (HCAs) are continuously exposed to humans in an ordinary lifestyle. In several Asian populations, an increased risk of lung cancer results among women from cooking and heating. There is increased risk of bladder, skin and lung cancers following consumption of water with high arsenic contamination, and by chlorination by-products. The estimates of the global burden of occupational and environmental cancer less than 1%, concentrated in subgroups of the population, exposure is involuntary and can be avoided (Boffetta, 2004). General awareness to the public about how to

reduce the carcinogenic load imposed by these carcinogens/chemicals and other substances would be an important contribution for the prevention of cancer and there for improving the health.

**Aim**

To review the adverse effect of chemical substances in food items and everyday items on health causing cancer or acting as carcinogens.

**Methods**

Bibliographical searches were performed in Pubmed for the terms "carcinogen," "chemical causing cancer", "lung cancer", "breast cancer", "indoor chemicals" "diet and colorectal cancer", "nutrition and colorectal cancer", alcohol and cancer" and "carcinogens in food.etc. and many more

**Discussion**

**Common Chemicals As Carcinogens**

The lists of chemicals have been developed by two highly respected agencies – the International Agency for Research on Cancer (IARC) and the US National Toxicology Program (NTP). The International Agency for Research on Cancer (IARC) has classified carcinogens according to their cancer-causing potential, into one of the following groups:

- Group 1: Carcinogenic to humans
- Group 2A: Probably carcinogenic to humans
- Group 2B: Possibly carcinogenic to humans
- Group 3: Unclassifiable as to carcinogenicity in humans
- Group 4: Probably not carcinogenic to humans

The following are examples of common environmental chemicals linked to cancer. Some are listed as known carcinogens by the International Agency for Research on Cancer (IARC), part of the World Health Organization, or by the Environmental Protection Agency.

**Table.1: Commonly Found Chemicals Known or Reasonably Anticipated to Be Human Carcinogens(Report on Carcinogens, 2011).**

| | | |
|---|---|---|
| Arsenic | Chromium (hexavalent) | Nickel |
| Asbestos | Coal Tars | Silica |
| Benzene | 1,4-dioxane | Styrene |
| Benzidine | Ethylene oxide | Sulfuric Acid |
| Butadiene | Formaldehyde | Toluene |
| Cadmium | Lead | Diisocyanate |
| Carbon Tetrachloride | Methylene Chloride | Trichlorethylene (TCE) Vinyl Chloride |

**Carcinogenic Effects on Health: Cancer**

A cell becomes cancerous when it grows quickly and uncontrollably. In most cancers, this process leads to the growth of tumors. A tumor is an abnormal

growth of tissue resulting from uncontrolled cell growth. Tumors are either benign or malignant. Benign tumors do not spread to other parts of the body. Malignant tumors can spread to other tissues and organs near the tumor. This spreading is called metastasis. Epidemiological studies of cancer reveals 80-90% of all cancers are due to environmental factors of which life style related factors are the most important and preventable (Doll &.Peto, 1981; Higginson & .Muir, 1979; WHO, 1997). These factors commonly include habits such as tobacco and alcohol consumption, excessive exposure to sunlight, chemicals and toxin.

**Table.2 : Showing different types of cancer and some substances as carcinogens**

| Type of Cancer | Substances as carcinogen |
|---|---|
| Lung | Arsenic, asbestos, cadmium, coke oven fumes, chromium compounds, coal gasification, nickel refining, foundry substances, radon, soot, tars, oils, silica |
| Nasal cavity , Larynx , Pharynx | Formaldehyde, isopropyl alcohol manufacture, mustard gas, nickel refining, leather dust, wood dust, Asbestos |
| Lymphatic and hematopoietic | Benzene, ethylene oxide, herbicides, x-radiation system |
| Liver | Arsenic, vinyl chloride |
| Bladder | Aluminum production, rubber industry, leather industry, benzidine |
| Skin | Arsenic, coal tars, mineral oils, sunlight |
| Soft-tissue sarcoma | Chlorophenols, chlorophenoxyl herbicides |

**Lung cancer** is the most common cancer in the world, both in terms of cases (1.6 million cases; 12.7% of total cancer cases) and deaths (1.4 million deaths; 18.2% of total cancer deaths)(Ferlay et al.,2010). Lung cancer is largely caused by tobacco smoke. Tobacco smoke is a complex mixture of more than 5,300 identified chemicals. The most important tumorigenic compounds in tobacco smoke are acrolein, formaldehyde, acrylonitrile, 1,3-butadiene, cadmium, acetaldehyde, ethylene oxide and isoprene. Second-hand tobacco smoke is also established human carcinogen (IARC Monographs, 2012).Cigarette smoke condensate contains a variety of mutagens and carcinogens. Exposure to indoor air pollution from combustion sources used for heating and cooking, as well as high levels of cooking oil vapors resulting from some cooking methods, may also cause lung cancer (Boffetta. P., Nyberg. F.,2003). Inorganic arsenic in drinking water may cause bladder, skin and lung cancers in humans(IARC ,2004). Acrylamide known as a potential carcinogen is used in the plastics industry. Acrylamide is also found in tobacco smoke. The amounts of acrylamide in the blood, had a higher risk of developing cancer (Olsen,2012). Various processes involving mining, refining and uses of some metals, particularly nickel and chromium, have been associated with occupational cancers of the respiratory tract.

**Breast cancer** is the second most common cancer (1.4 million cases, 10.9%), but ranks 5th as cause of death (458,000, 6.1%). Increased risk of breast cancer is associated with persistently elevated blood levels of estrogen (Yager et al.,2006). Estradiol, can be metabolized to quinone derivatives that adducts with DNA. Some studies suggest phytoestrogen which are estrogen compounds found in many plants and plant products, including soy food products consumed during adolescence may reduce later risk of breast cancer, but other studies suggest it may cause oxidative DNA damage and interfere with breast cancer drugs. Several studies have shown an association between dairy consumption and breast cancer in pre-menopausal women. Bovine growth hormone rBGH has also been shown to raise insulin-like growth factor levels in the body, associated with an increased risk of breast cancer. Phthalates can be found in some plastic food containers and are considered carcinogen. Bisphenol A (BPA) found in reusable plastic food containers and the lining of food and beverage cans dioxin, and perfluorooctanoic acid (PFOA) have been shown to alter gene expression and/ or modify mammary gland development, increasing the risk of cancer in laboratory animals, (Dairkee, et al 2008). Styrene

is an animal mammary carcinogen and is possibly carcinogenic to humans. Styrene can leach from polystyrene – a component of styrofoam food trays, egg cartons, disposable cups and carryout containers – when heated, worn or put under pressure. Although few epidemiologic studies have been conducted for chemical exposures, occupational studies show associations between breast cancer and exposure to certain organic solvents and polycyclic aromatic hydrocarbons(PAHs) ( Julia and Ruthann 2003). Recently, natural estrogens have been classified as known human carcinogens. Prenatal exposure to natural and synthetic estrogens is associated with increases in breast and vaginal tumors in humans. Recently, a prototypical endocrine-disrupting compound, 2,3,7,8-tetrachlorodibenzo-p-dioxin, has been shown to be a developmental toxicant of the mammary gland in rodents.

Pesticides sprayed on crops, antibiotics used on poultry, and hormones injected into cattle, sheep may increase breast cancer risk. Of 30 commonly used lawn pesticides 19 have are carcinogens, 13 are linked with birth defects, 21 with reproductive effects, 15 with neurotoxicity, 26 with liver or kidney damage, 27 are sensitizers and/or irritants, and 11 have the potential to disrupt the endocrine (hormonal) system( EPA. 2003) .

Experimental Toxicology Division, National Health and Environmental Effects Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina, USA. birnbaum.linda@e**Colorectal cancer** is the third most common cancer 1.2 million cases (9.4%), 608,000 deaths (8.0%). Chemicals formed when muscle meat, including beef, pork, fish, or poultry, is cooked using high-temperature methods, such as pan frying or grilling directly over an open flame. In laboratory experiments, HCAs and PAHs have been found to be mutagenic—that cause changes in DNA that may increase the risk of cancer. PAHs are formed when fat and juices from meat grilled directly over an open fire drip onto the fire, causing flames. These flames contain PAHs that then adhere to the surface of the meat. PAHs can also be formed during other food preparation processes, such as smoking of meats. Cooking meat at high temperatures may lead to the formation of mutagenic and carcinogenic heterocyclic amines through the interaction of muscle creatinine with amino acids (Sugimura et al,2004). Haem in meat can act as a nitrosating agent promoting the formation of N-nitroso compounds. Darker meats are more abundant in haem than white meats and therefore, high consumption of red meat (beef, pork, or lamb) could increase the

risk of colorectal cancer( Bonnett,1975; Kuhnle,2007). HCAs in food are mainly produced from creatin(in)e, sugar and from amino acids in meat (upon heating). They are imidazoquinoline and imidazoquinoxaline derivatives and phenylimidazopyridine. HCAs are pluripotent in producing cancers in various organs including breast, colon and prostate. PAHs can be found in other charred foods, as well as in cigarette smoke and car exhaust fumes. foods, heterocyclic amines in heated meat and fish, and pyrrolizidine alkaloids from plants (Sugimura et al.,1984; 1986; Ames, 1983)). Cooking methods that expose meat to smoke or charring contribute to PAH formation (Jagerstad etal.,2005). Tobacco smoke may be responsible for up to 20% of colorectal cancers in the United States. The bile acids deoxycholic acid (DCA) and/or lithocholic acid (LCA) induce production of DNA damaging DNA damage would tend to accumulate mutations, and such cells may give rise to colon cancer (Bernstein et al.,2009).

**Stomach cancer** is the fourth most common cancer [990,000 cases (7.8%), 738,000 deaths (9.7 %). *Helicobacter pylori* infection is the main causative factor in stomach cancer ( Ferlay et al.,2010). In chemical industry certain aromatic amines led to a 30-fold increased risk of workers developing **bladder cancer**. Mesothelioma of the pleura and peritoneum, and haemangiosarcoma of the liver, rare forms of cancer can arise in workers exposed to asbestos dust and vinyl chloride respectively. A variety of plants and micro-organisms also produce carcinogenic metabolites. Aflatoxins, metabolites of a fungus contaminating foodstuffs, may cause **liver cancer**. Synthetic halogenated chemicals increase liver tumors after early life-stage exposure.

**Prostate cancer :** Prostate cancer is the most frequently diagnosed cancer in men, killing 40,000 each year. Bisphenol A (BPA) may account for prostate cancer. There is direct link between low-dose BPA exposure during development and later prostate cancer. BPA has been in use for about 50 years in the industrialized world. BPA from polycarbonate food and drink containers might enter human tissues and increases prostate cancer rates (Julian Josephson,2006). There is increased risk of prostate cancer for men with occupational exposures to a wide variety of chemicals – such as farmers, tire plant workers and painters – and those who eat a high fat diet or alcohol. In a study men exposed to methyl bromide a pesticide had a 1.62-fold increased risk of prostate cancer compared to the men who were never exposed (Cockburn,et al.,2011).

**Conclusion**

Today we are surrounded by chemicals in the form of everyday items and it is impossible to avoid them. A number of food additives, pesticides, insecticides and industrial chemical exposure to occupation hazards or to drugs have caused human cancers. We are unaware of their presence in our food and other usable products. Moreover, human cancers are not produced by a single carcinogenic agent but rather are the result of many carcinogenic compounds, each acting at very low exposure levels. Knowledge of everyday substances and other carcinogenic factor and their carcinogenic effects can contribute to suppression of carcinogenesis. The Promotion of preventive strategies can be applied to public awareness activities. The key to avoiding cancer-causing foods is knowing the ingredients as carcinogens avoid consuming those ingredients. Pre-cooking meats in a microwave oven for 2–3 minutes before grilling shortens the time on the hot pan, and removes heterocyclic amine (HCA) precursors, which can help minimize the formation of these carcinogens. Further Research is needed to unearth the presence of chemicals in our surrounding and also aware the common people about the carcinogenic effect of these chemicals on health for prevention

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