

Chemical Carcinogenesis

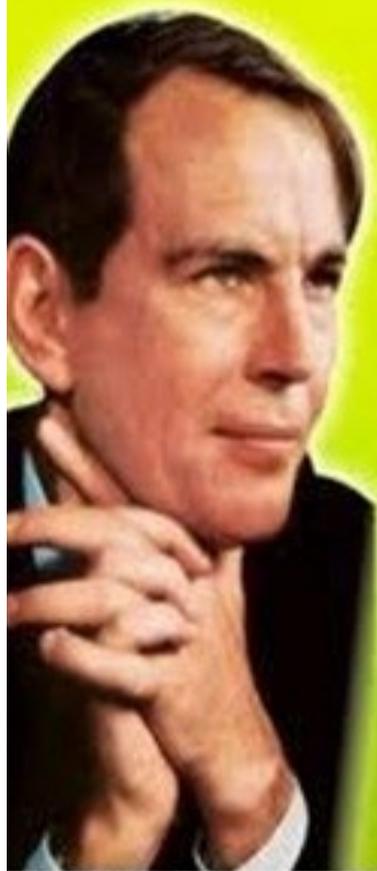


Chemical Carcinogenesis



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I don't believe medical discoveries are doing much to advance human life. As fast as we create ways to extend it we are inventing ways to shorten it.

Christiaan Barnard

Outline

- Introduction
- Classification
- Mechanism
- Carcinogens in our daily life
- Plastics
- Take home message .

What is a Chemical carcinogen?

- ✿ Any discrete chemical compound which has been shown to cause cancer in human or animal studies.
- ✿ Hundreds of individual compounds have been shown to induce cancers. Many thousands of additional compounds are “suspect” carcinogens.
- ✿ Many are commonly used in laboratory operations, shops and art studios.

Which classes of chemicals tend to be carcinogens?

- ❁ Epoxides:
 - Ethylene oxide
 - Propylene oxide
- ❁ Organohalogen comp.:
 - Vinyl chloride Carbon tetrachloride
 - Chloroform
 - Hexachlorobenzene
 - Trichloroethylene
- ❁ Hydrazines:
 - Hydrazine (and salts)
 - 1,2-Dimethylhydrazine
- ❁ N-Nitroso compounds:
 - N-Nitrosodimethylamine
- ❁ Aromatic Amines:
 - Benzidine Aniline
 - o-Anisidine o-Toluidine
- ❁ Aromatic hydrocarbons:
 - Benzene
 - Benz[a]anthracene
 - Benzo[a]pyrene

Classes of carcinogens (cont.)

❁ Misc. organic compounds:
Formaldehyde
Acetaldehyde 1,4-
Dioxane Ethyl
carbamate 2-
Nitropropane Styrene
Thiourea
Thioacetamide

❁ Misc. inorganic comp.
Arsenic and compounds
Chromium and comp.
Thorium dioxide
Beryllium and
compounds Cadmium
and compounds Lead
and compounds Nickel
and compounds
Selenium sulfide.

How do carcinogens enter the body?

- Skin absorption. Many solvents and other chemicals go directly through the skin.
- Ingestion. Swallowing of a carcinogen.
- Inhalation. Breathing gases, fumes and vapors is the most common form of exposure.

Mechanism

- Chemical carcinogens undergo metabolic activation by cytochrome P450 or other metabolic pathway and react with DNA or alter epigenetic mechanism .
- DNA is considered the ultimate target for most carcinogens to cause mutations or gross chromosomal changes.
- Formation of DNA Adducts occurs by binding of chemicals to DNA

- Carcinogen -DNA Adducts leads to base mutation or gross chromosomal changes ,so that it can cause base substitution ,deletion ,insertion duroing DNA replication .

**Carcinogenic
Chemicals in
our daily life.**



All charred food, which create heterocyclic aromatic amines, known carcinogens. Even dark toast is suspect.



Charred Foods



Refined 'white' flours

Refined flour is a common ingredient in processed foods, but its excess carbohydrate content is a serious cause for concern.

Regular consumption of refined carbohydrates was linked to a 220 percent increase in breast cancer among women. High-glycemic foods in general have also been shown to rapidly raise blood sugar levels in the body, which directly feeds cancer cell growth and spread.

Microwave Popcorn

The Microwave Popcorns contain **Perfluorooctanoic acid (PFOA)** and which is a likely carcinogen. The inhalation of vapour of artificial butter present in it which contains dangerous chemicals and can cause kidney and lung cancers.

Perfluorooctanoic acid (PFOA)- Use in food wrappers, candy wrappers.

Fruit Ripening agents(Carcinogens)

- With the development of fruit trade the fruits are sent to distant places, requiring several days in ordinary or refrigerated transportation and only firm and mature fruits are least damaged during marketing.
- The fruits are ripened at the destination markets before retailing and hence artificial ripening has become essential.

- The most commonly used chemical for artificial ripening is **Calcium Carbide (CaC_2)** and is popularly known as ‘Masala’, though banned under PFA Rules, 1955 and also under Food Safety and Standards (Prohibition and Restrictions on Sales) Regulations.
- Calcium Carbide is colourless when pure, but greyish-white to black in colour otherwise, with garlic like odour.

- When it reacts with water, it produces acetylene gas (popularly referred to as carbide gas) which is an analogue to ethylene and quickens the ripening process. It is said to have the same effect as ethylene the natural ripening hormone.
- $\text{CaC}_2 + 2\text{H}_2\text{O} \rightarrow \text{C}_2\text{H}_2 + \text{Ca}(\text{OH})_2$

- However, acetylene is not nearly as effective for ripening as is ethylene and acetylene is not a natural hormone as ethylene. Calcium Carbide contains traces of **Arsenic and Phosphorous hydride**.
- A strong reactive chemical, Calcium Carbide has carcinogenic properties and is used in gas welding. Being cheap and easily available in the local markets, CaC_2 is indiscriminately being used in preference to other recommended practices of inducing ripening in fruits



Adulteration in olive oil



Your food label
didn't tell you
that

extra virgin
olive oil
may contain

DEODORANT

Adulteration in pickles



Some Adulterated Foods in market



Turmeric, dals and pulses

- Adulterant: Metanil Yellow and Kesari Dal
- Health hazard: highly carcinogenic, stomach disorders.



Green chillies, green peas&other vegetables

- Adulterant : Malachite Green, Argemone seeds
- Health hazard: carcinogenic if consumed over a long period of time



Mustard seeds and mustard oil

- Adulterant : Argemone seeds, Papaya seeds
- Health hazard: epidemic dropsy and severe glaucoma



Paneer, khoya, condensed milk and milk

- Adulterant: Starch and water
- Health hazard: stomach disorders



Ice cream

- Adulterant: Pepperonil, Ethylacetate, Butraldehyde, Nitrate, Washing powder etc
- Health hazard: Pepperonil is used as a pesticide and ethyl acetate causes diseases affecting lungs, kidneys and heart.



Coffee powder

- Adulterant : Tamarind seeds, chicory powder
- Health hazard: diarrhea, stomach disorders, giddiness and severe joint pains

Some other adulterants...

- Cream is adulterated with gelatin, and formaldehyde is employed as a preservative for it.
- Butter is adulterated to an enormous extent with oleomargarine, a product of beef fat.
- Brick dust in chilli powder, colored chalk powder in turmeric.
- In confectionery, dangerous colors, such as chrome yellow, prussian blue, copper and arsenic compounds are employed.
- Pickles and canned vegetables are sometimes colored green with copper salts.



सब्जियों का काला सच



फलों के रस जहरीले



Not just Maggi, more than 400 other products are rejected by FSSAI including ones from Tata Starbucks, Kellogg's etc

Earlier Indian Veterinary Research Institute discovered in a survey in 2013 that 28 per cent of the eggs sampled in Bareilly, Izzatnagar (Uttar Pradesh) and Dehradun (Uttarakhand) were contaminated with E.coli.

In 2012, a study in India conducted by the Food Safety Standards Authority of India (FSSAI) across 33 states found that milk in India is adulterated with detergent, fat and even urea, as well diluted with water. Of the 1791 random samples from 33 states, just 31.5% of the samples tested (565) conformed to the FSSAI standards while the rest 1226 (68.4%) failed the test.

POISON IN YOUR FOOD

CHEMICALS/COLOURS USED IN FRUITS AND VEGETABLES

▶ **Calcium carbide** | Used to ripen fruits like mangoes, bananas

▶ **Copper sulphate** | Used to ripen fruits faster

▶ **Oxytocin** | Hormone used for faster growth of pumpkin, watermelon, brinjal, gourd, cucumber

▶ **Wax** | Adds shine on apples and pears

▶ **Cheap colours** | Green colour containing harmful chemicals such as metallic lead is applied to bitter gourd & other leafy vegetables to give fresh look

▶ **Saccharin** | Used to sweeten the watermelons etc

▶ **Pesticides & herbicides** | Used excessively for growing fruits, vegetables

HEALTH HAZARDS

▶ Consumption of chemical-laden fruits and vegetables can prove disastrous for **digestive system, eyes & liver**

▶ Can result in vomiting and diarrhoea in children

▶ **Kidney failure**

▶ Oxytocin can lead to damage of the brain

WHAT YOU CAN DO

▶ Wash fruits & vegetables in lukewarm water before eating

▶ Use the locally-grown fruits and vegetables

▶ Always wash hands before preparing meals

▶ Remove & discard outer leaves of lettuce & cabbage



Health News / Latest Health News / Industry

Industry Unadulterated Ida Care Hospital cancer cases AGMARK

‘Food adulteration a major cause of increasing prevalence of cancer’

The increased incidence of lifestyle diseases like cancer can directly be ascribed to consumption of adulterated food, according to experts. The good news is that in case of several foodstuffs, the adulteration can be caught by simple methods.

Payal Gwalani | TNN | January 15, 2016, 17:15 IST

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Nagpur: The increased incidence of lifestyle diseases like cancer can directly be ascribed to consumption of adulterated food, according to experts. The good news is that in case of several foodstuffs, the adulteration can be caught by simple

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68% milk & milk products in India not as per FSSAI standard: Official

The Animal Welfare Board member said the adulterants in milk are hazardous and can cause irreversible damage to human organs.

PTI | Sep 05, 2018, 07:36 PM IST



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LUDHIANA: Around 68.7 per cent of milk and milk products sold in the country is not as per the standards laid down by the [Food Safety and Standards Authority of India \(FSSAI\)](#), a member of the Animal Welfare Board said Wednesday.

THIS STORY IS FROM FEBRUARY 23, 2019

80kg adulterated paneer, sauces seized during raid

TNN | Updated: Feb 23, 2019, 10:21 IST



A-

A+



JAIPUR: The food department in separate raids carried out on Friday seized 800 kg of adulterated paneer and 2,100 kg of inferior quality sauces. The searches conducted at Sharma Paneer Udhog by the

Paneer

- They come from an odious mixture of maida, palm oil, baking powder, old discarded skimmed milk, **detergent**, bicarbonate of soda and Suphuric Acid.
- The same **sulfuric acid** that is found in lead-acid batteries, metal cleaners, drain cleaners and anti-rust products. This is boiled till it becomes a semi solid product.

MITIGATION MEASURES FOR ADDRESSING FOOD ADULTERATION

- There must be proper surveillance of the implementation food laws.
- There should be monitoring of the activities with periodical records of hazards regarding food adulteration.
- There should be periodical training programmes for Senior Officer/Inspector/Analysts for food safety

- 
- There should be consumer awareness programmes organized by holding exhibitions/seminars/training programmes and publishing pamphlets.
 - There should be strict actions regarding the punishment for those who are involved in food adulteration.
 - There should be help and support from International INGOs for implementation of food laws.

Plastics and cancer

- Food and beverage containers, some disposable plates, and toiletry bottles are all plastic and all are made from chemicals. Research suggests that all plastics may leach chemicals if they're scratched or heated. Research also strongly suggests that at certain exposure levels, some of the chemicals in these products, such as bisphenol A (BPA), may cause cancer in people.

- BPA is weak synthetic estrogen found in many plastics products .
- Its estrogen like activity makes it hormone disruptor and can cause breast cancer .
- Bisphenol S and Bisphenol F are alternatives of BPA, and considered safe .
- However recent studies have revealed that estrogenic activity is same and even greater than BPA.

Low dose BPA Exposure: A Seemingly instigating carcinogenic effect on breast cancer. Advanced science, Zhe Wang, Huiyu, Sijin liu .

Styrene

- Also known as ethenylbenzene, derivative of benzene colourless liquid .
- It is used to make latex, synthetic rubber and polystyrene resins .
- These resins are used to make plastic packaging, disposable cups and containers.
- Styrene and its metabolites are carcinogenic.

Fertilizers

Pesticides

Insecticides



Pesticides and cancer

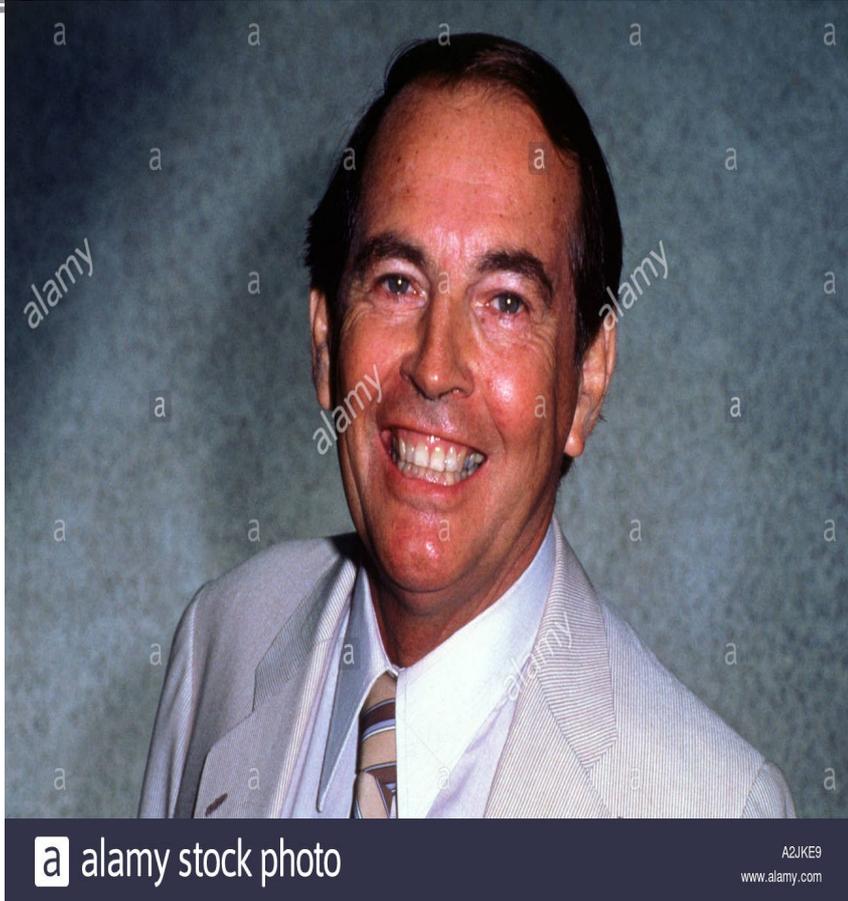
- Three chemicals used as pesticides – arsenic, ethylene oxide and lindane – are among agents rated as Group 1 carcinogens, or conclusive causes of cancer, by the International Agency for Research on Cancer (IARC), as is the chemical 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), which may occur as a contaminant in certain pesticides.

- Poisonous or deleterious substances
- Filth and foreign matter
- Economic-adulteration
- Microbiological contamination and adulteration

PESTICIDES: HITTING YOU ALL OVER	
Pesticides	Toxic impact
Chlorpyrifos	Nerve damage
Endosulfan-T	DNA mutation, hormone disorders, neurotoxicity
Heptachlor	Nervous system and liver damage
Quinalphos	Developmental, reproductive, neurological damage
Aldrin	Cancer, infertility
Chlorfenvinphos	Developmental, reproductive, neurological damage
Chlordane	Affects nervous system, lungs, liver, kidneys, eyes
DDT	Cancer, hormone disorders, infertility



Prevention



□ "I have saved the lives of 150 people from heart transplantations. If I had focused on preventive medicine earlier, I would have saved 150 million"

-Christiaan Barnard,
heart transplant
surgeon



Take home message

- Exposure to environmental carcinogens may contribute significantly to causation of human cancers .
- Food adulteration is increasing day by day and it is also one of the reason of increasing incidence of cancer.

To reduce exposure to BPA:

- **Carry your own glass, steel, or ceramic water bottle** filled with filtered tap water.
- **Reduce how much canned food you eat and how much canned formula your baby uses.**
- **Use baby bottles with labels that say "BPA free."**

.Ref:Breastcancer.org

- **Don't cook food in plastic containers ;** the plastic residues may leach into food when heated in a regular or microwave oven.
- **Use glass, porcelain, enamel-covered metal, or stainless steel pots, pans, and containers for food and beverages** whenever possible, especially if the food or drink is hot.
- Ref:Breastcancer.org

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- **Wash** fruits and vegetables in leukewarm water before eating .
 - Use **locally grown** fruits and vegetables .
 - **Remove and discard** outer layer of fruits and vegetables .

Thank You

