



Carcinogens in Tobacco Smoke



Key Messages

- Tobacco smoke contains over 4,000 chemicals, of which more than 70 are known to cause, initiate or promote cancer and are called “carcinogens”.
- Exposure to tobacco smoke increases the risk of developing cancer.
- Health Canada recommends that Canadians stop smoking and avoid second-hand smoke.

A wide variety of chemicals such as nicotine, sugars, minerals and proteins, are naturally-occurring in tobacco leaves. During the burning of a cigarette (combustion), both the chemicals which exist naturally in the tobacco and the new chemicals which are formed during the combustion are released into the tobacco smoke. To date, over 4,000 chemicals, comprising a combination of gases, liquids and breathable particles, have been identified in tobacco smoke. Of the 4000 chemicals, more than 70 chemicals are known to cause, initiate or promote cancer (1, 2).

According to the International Agency for Research on Cancer (IARC), a carcinogen is defined as an agent (e.g. chemical) that can increase the risk of cancer (3). IARC classifies a chemical as a carcinogen when there is sufficient evidence in scientific studies in humans, animals and/or other relevant sources to show that the chemical is capable of causing the development or increasing the incidence of cancer. IARC classifies the carcinogenic risk¹ of chemicals to humans under different categories based on the degree of evidence from the scientific studies (**Table 1**).

Table 1: The four groups used to categorize a chemical with carcinogenic risk to humans

Category	Definition
Group 1	The chemical is carcinogenic to humans .
Group 2A	The chemical is probably carcinogenic to humans .
Group 2B	The chemical is possibly carcinogenic to humans .
Group 3	The chemical is not classifiable as to its carcinogenicity to humans .
Group 4	The chemical is probably not carcinogenic to humans .

¹ The term “carcinogenic risk” is used by IARC to mean the probability that exposure to a chemical will lead to cancer in humans

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Tobacco smoke has been classified by IARC as a Group 1 carcinogen (4). Examples of the chemicals which have been identified in tobacco smoke as carcinogens, and linked with the development of cancer, are presented in **Table 2**.

Exposure to the carcinogens present in tobacco smoke increases the risk of developing cancer. Health Canada recommends that Canadians stop smoking and avoid second-hand smoke.

Table 2: Examples of carcinogens in tobacco smoke with their IARC classification

IARC classification (Overall evaluation of the degree of evidence for carcinogenicity based on human and animal evaluation)	EXAMPLES OF Tobacco smoke carcinogens
Group 1	Arsenic
	Benzene
	Benzo[<i>a</i>]pyrene
	Cadmium
	Chromium (Hexavalent)
	Formaldehyde
	4-(<i>N</i> -Methylnitrosoamino)-1-(3-pyridyl)-1-butanone (NNK)
	Nickel
Group 2A	<i>N</i> -Nitrosornicotine (NNN)
Group 2B	Lead (inorganic)
	Acetaldehyde
	Acrylonitrile
	Isoprene
	Styrene

References

1. A Report of the Surgeon General, *How Tobacco Smoke Causes Disease: What it Means to You*, 2010, page 5.
2. Stephen S. Hecht, *Research Opportunities Related to Establishing Standards for Tobacco Products Under the Family Smoking Prevention and Tobacco Control Act*, Nicotine Tobacco Research, first published online January 10, 2011. Available from: <http://ntr.oxfordjournals.org/content/early/2011/01/09/ntr.ntq216.full>
3. World Health Organization, International Agency for Research on Cancer, IARC, [Cited 2011 Feb 07]. Available from: <http://monographs.iarc.fr/>
4. World Health Organization, International Agency for Research on Cancer, IARC, *Monographs on the Evaluation of Carcinogenic Risks to Humans*, 2002, Volume 83, Tobacco Smoke and Involuntary Smoking, page 1187.