

NICOTINE AND OTHER POISONS

WHAT'S IN TOBACCO SMOKE?

There are more than 4000 chemicals in tobacco smoke.^{1,2} Nicotine, tar and carbon monoxide are well known. Nicotine is the addictive drug that keeps you coming back for more. Tar is the black, sticky substance that damages your lungs. Carbon monoxide is the gas that hitches a ride on your red blood cells and takes the place of some of the oxygen in your bloodstream.

Some of the other chemicals found in cigarettes (and some of their other uses) are:^{1,2}

- ammonia (household cleaning agent);
- acetone (nail polish remover);
- naphthalene (mothballs);
- methanol (rocket fuel);
- formaldehyde (which preserves the dead);
- phenol (disinfectant);
- hydrogen cyanide;
- metals (76 metals including arsenic, cadmium, nickel);
- radioactive compounds (polonium-210 and potassium-40);
- acetic acid (vinegar);
- toluene (industrial solvent);
- pesticides.

WHAT'S NICOTINE?

Nicotine is a chemical substance found in tobacco leaves. Addiction to nicotine is what keeps you smoking. Nicotine is as addictive as heroin or cocaine.³

HOW DOES NICOTINE WORK?

From the moment that you inhale tobacco smoke, it takes four seconds for the nicotine to reach your blood stream and about 10 seconds to reach the brain.⁴ Once the nicotine has attached itself to special sites in the brain, many relaxing chemicals are released. But this effect only lasts for a short time and then the addicted smoker needs to 'top up' their nicotine. One of the reasons people continue to smoke is because they enjoy the effect of these relaxing chemicals being released by the brain.⁵

WHY IS NICOTINE A PROBLEM FOR HEALTH?

The worst problem for health caused by nicotine is that it is so addictive. Most regular smokers would prefer not to smoke and only continue because they are addicted to nicotine. Smoking tobacco accounts for the largest proportion of preventable illness and death in Australia. Immediate effects of nicotine on the body include increased heart rate and blood pressure and constriction

of blood vessels. Over time, ingestion of nicotine from smoking combines with carbon monoxide to damage the lining of blood vessels and make blood platelets stickier. In combination, these effects contribute to the development of heart disease.⁵

Although nicotine is among the most toxic and fast acting of all poisons, the dose from smoking is too low to cause acute poisoning (smoking poisons you slowly). However, there is a serious risk for children who ingest cigarettes and care should be taken with cigarettes and extinguished butts, which contain concentrated nicotine. Before developing a tolerance to nicotine, the smoker may experience mild effects of nicotine toxicity.⁶ The nicotine in nicotine replacement therapy (NRT) products, such as the patch, gum, lozenge, sublingual tablet or inhaler, is safe if used according to the product directions. The average dose of nicotine from NRT is about one-third to one-half of that obtained from smoking.^{7,8,9} A person who is dependent on nicotine is extremely unlikely to experience any toxic effect from using NRT.

HOW DOES YOUR BODY GET RID OF NICOTINE?

Most of the nicotine (80 per cent) is broken down in the liver. Nicotine is also filtered from the blood by the kidneys and removed in urine.

WHAT IS TAR AND WHY IS IT A PROBLEM FOR HEALTH?

The word 'tar' describes the particulate matter which, generated by burning tobacco, forms a component of cigarette smoke.¹⁰ Each particle is composed of a large variety of chemicals consisting mainly of nitrogen, oxygen, hydrogen, carbon dioxide, carbon monoxide, and a wide range of volatile compounds.^{1,10}

In condensed form, tar is a sticky brown substance that is the main cause of lung and throat cancer in smokers.¹⁰ Tar can also cause unsightly yellow-brown stains on fingers and teeth. Some tar is exhaled, some is coughed up, and some is absorbed by the lungs, which can cause lung cells to die. Cigarette smoke damages the 'cilia' (fine hairs that line the upper airways to protect against infection). When cilia are damaged, tar can penetrate further into the lungs.

WHAT IS CARBON MONOXIDE AND WHY IS IT A PROBLEM FOR HEALTH?

Carbon monoxide is a poisonous gas that competes with oxygen in the blood.¹¹ This is the same gas that is found in car exhaust fumes. Carbon monoxide binds to red blood cells, making it harder for the body to carry oxygen to the

muscles and organs.¹² In large quantities, carbon monoxide is rapidly fatal. Smokers can have up to 10 times the amount of carbon monoxide in their bloodstream than non-smokers.¹³ Heavy smokers may have the oxygen carrying ability of their blood cut by as much as 15 per cent.¹⁴ Smoking in pregnancy can lead to a dramatic reduction in the amount of oxygen available to the developing baby.

OTHER CHEMICALS AND ADDITIVES

As tobacco is not classified as a food or drug in Australia,¹⁵ there are no standards or controls on what may be used in the growing and production of tobacco, including additives and agricultural chemicals.¹⁶ Herbicides, insecticides, fungicides, fertilisers and other agricultural chemicals are routinely used in tobacco growing.^{16,17}

Additives are added to cigarettes in the manufacturing process to:^{11,17}

- add flavour, including sugar, honey, liquorice, cocoa, and chocolate liqueur to lessen the harshness of the smoke;¹⁸
- lessen the irritating effects of smoke. Menthol and eugenol numb the throat;¹⁸
- change the chemistry of nicotine. Ammonium salts and acetaldehyde (in burnt sugar) increase nicotine's addictive potential;^{11,18}
- change the chemistry of smokers' brains to make them more receptive to nicotine.¹⁸

There are a number of problems with additives:

- Additives such as sugar and honey might seem harmless, because we are used to eating them, but when additives in cigarettes are burnt, they can change into different chemicals, some of which are toxic. For example, liquorice and sugar produce cancer-causing chemicals when burnt. Also, these substances are inhaled into the lungs, which are delicate and much more vulnerable to harm than the stomach and intestines.¹⁸
- The health effects of additives on smokers are not made public by the tobacco companies and many may not be known at all.¹⁸
- Some additives make tobacco smoke less harsh and taste better. It may make it easier for children to learn to smoke and make smoking more agreeable to smokers.¹⁸

There is no such thing as a 'safer' cigarette or 'healthier' tobacco. All tobacco smoke is damaging to health. The best way to prevent exposure to the chemicals in tobacco smoke is to avoid exposure to tobacco smoke.

REFERENCES

1. US Department of Health and Human Services. *Reducing the health consequences of smoking: 25 years of progress. a report of the Surgeon General*. Rockville, Maryland: US Department of Health and Human Services, Public Health Service, Centers for Disease Control, Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 1989.
2. US Environmental Protection Agency. *Respiratory health effects of passive smoking: lung cancer and other disorders*. Washington DC: Office of Health and Environmental Assessment, Office of Research and Development, US Environmental Protection Agency, 1992.
3. Royal College of Physicians. *Nicotine addiction in Britain: a report of the tobacco advisory group of the royal College of Physicians*. London: Royal College of Physicians, 2000.
4. US Department of Health and Human Services. *Preventing tobacco use among young people: A report of the Surgeon General*. Atlanta, Georgia: US Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention, Office on Smoking and Health, 1994.
5. US Department of Health and Human Services. *The health consequences of smoking: nicotine addiction: a report of the US Surgeon General*. Rockville, Maryland: US Department of Health and Human Services, Office on Smoking and Health, 1988.
6. Winstanley M, Woodward S, Walker N. *Tobacco in Australia: facts and issues 1995*. Melbourne: Quit Victoria, 1995.
7. Benowitz NL. Nicotine replacement therapy during pregnancy. *JAMA* 1991; 266: 3174-3177.
8. McKendree E, McNabb MD, Richard V. et al. Plasma nicotine levels produced by chewing nicotine gum. *JAMA* 1982; 248: 865-868.
9. Pharmacia Consumer Healthcare Australia. *Product information* 2001.
10. US Department of Health and Human Services. *The health consequences of smoking: the changing cigarette*. Rockville, Maryland: US Department of Health and Human Services, Public Health Service, Office on Smoking and Health, 1981.
11. US Department of Health and Human Services. *The FTC cigarette test method for determining tar, nicotine and carbon monoxide yields of US cigarettes. Report of the NCI Expert Committee. Smoking and Tobacco Control Monograph no. 7*. Bethesda, Maryland: US Department of Health and Human Services, Public Health Service, National Institutes of Health, 1996.
12. US Department of Health and Human Services. *The health consequences of smoking: cardiovascular disease. a report of the US Surgeon General*. Rockville, Maryland: US Department of Health and Human Services, Office on Smoking and Health, Public Health Service, Department of Health Education and Welfare, 1983.
13. Rodrigo C. The effects of cigarette smoking on anesthesia. *Anesth Prog* 2000 (Winter); 47(4): 14350.
14. Royal College of Physicians. *Smoking or health*. London, Pitman, 1977.

15. Commonwealth Department of Health. *Tobacco is specifically exempted from the Uniform Poisons Schedule: Standard adopted by the National Health and Medical Research Council, 94th Session*. Canberra: Commonwealth Department of Health, 1982.
16. Chapman S. Come to where the flavour is: additives and pesticide residue in cigarettes. *Drug Alcohol Rev* 1992; 11: 3–6.
17. International Agency for Research on Cancer. *Tobacco smoking. IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Humans. Volume 38*. Geneva: World Health Organization, 1985.
18. Bates C, Jarvis M, Connolly G. *Tobacco additives: cigarette engineering and nicotine addiction*. London: Action on Smoking and Health, 1999. ☒

This fact sheet is one of a series on tobacco and health related issues produced by the Tobacco and Health Branch of the NSW Department of Health. The fact sheets respond to frequently asked questions and are designed to be used by both consumers and health professionals to help people to quit smoking.

The fact sheets can be accessed through the NSW Department of Health's website at www.health.nsw.gov.au/public-health/health-promotion/tobacco/facts/index.html.



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