



Fact or Fiction?

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Cyanide: Watch What You Eat & Breathe

Cyanide scares a lot of people. The electroplating community has learned how to work with this chemical and in many instances has found replacements for it, but ironically, cyanide is more ubiquitous in our everyday lives than most people realize.

The mere mention of the word cyanide evokes the response, poison. An evil reputation has shadowed this chemical for a long time. Gas chambers rely on cyanide. In plays, novels, movies, and television dramas, homicide by way of cyanide poisoning has been and continues to be, a favorite theme. In one of history's most bizarre suicide-murder rites conducted at Jonestown, Guyana, under the direction of cult leader Jim Jones on November 18, 1978, almost all of the more than 900 victims died from cyanide poisoning.¹

In spite of all the danger associated with cyanide, it pales in comparison with some natural toxins found in nature as shown in Table 1. Synthetic versus natural? The three most toxic chemicals known to date are natural products—botulinum toxin (less than 1 mg needed to kill a man), tetanus toxin, and diphtheria toxin. Curare and strychnine kill natural plant products and are three and two orders of magnitude, respectively, more toxic to mice than sodium cyanide.²

So, where is cyanide found in our everyday lives? Foods, tobacco smoke and fumes from a variety of fires are all sources.

Cyanide in Food

As Baarschers³ has pointed out: "A very large body of knowledge about food and food chemicals has almost been forgotten or is ignored." A monograph by Liener⁴ contains some 3,000 references to the literature on thou-

sands of chemicals isolated from common vegetables that have been shown to have the potential to cause negative effects on human and animal health. Let's look at some of the information on cyanide in foodstuffs.

At least six different cyanogenic glucosides have been identified in edible plants: amygdalin, prunasin, dhurrin, sambunigrin, lotaustralin and linamarin.⁵ These chemicals have been detected in 110 different plant families and in over 2000 plant species, including several commonly consumed in the human food chain.⁴ Degradation of cyanogenic glucosides creates hydrogen cyanide. Table 2 lists hydrogen cyanide levels liberated from a variety of common food crops. Certain grasses, pulses, root crops and fruit kernels contain these cyanogenic glucosides, which can be life-threatening. Foods containing these cyanide compounds that are generally consumed by humans include cassava, sweet potato and yam; maize and millet; bamboo and sugar cane; peas and beans, and especially lima or butter bean; kernels of almond, lemon lime, apple, pear, cherry, apricot and plum, including the prune.⁵ Regarding lima beans: 80 mg of HCN will kill an average person and this is the amount contained in 3.7 pounds of lima beans.⁶ Now you know why no restaurant will feed you 3.7 pounds of lima beans. Not only will this kill you, but think what it would

Table 1
Relative Potency of Some Classes of Chemicals²

Class of Chemicals	Lethal Dose to Mice, $\mu\text{g}/\text{kg}$ body weight
Bacterial toxins	0.00003 to 1
Animal venoms	10 to 100
Algal toxins	10 to 1,000
Mushroom toxins	1,000s
Mycotoxins	1,000 to 10,000
Sodium cyanide	10,000
Pesticides	10,000s

do to the people sitting around you! Cabbage, radish, cauliflower, mustard, and horseradish are full of isothiocyanates, which can be metabolized to mutagens, and also to cyanide derivatives. Cabbage, for example, has 40 natural pesticides and metabolites, 10 of which are cyanide derivatives.⁷ Stoa⁸ has demonstrated that thiocyanate is present in considerable but variable amounts in green vegetables and milk.

Although all of this clearly shows that cyanide is present in a variety of foods mere mention of cyanide in foodstuffs can whip up a frenzy since the media go berserk at discovery of cyanide. Cohl⁹ asks the question: "How many cyanide-laced grapes does it take to kill someone? A bunch? Ten? Twenty?" In 1989, two grapes from Chile were found to contain non-lethal amounts of cyanide, and this led to the U.S. FDA pulling all fruit from Chile off supermarket shelves and stopping all imports. This cost the U.S. economy at least \$20 million, and that's \$10 million per grape when these grapes weren't going to hurt anyone even if they were plucked and eaten.

Cyanide from Tobacco Smoke

More than 4,000 hazardous compounds are present in the smoke that smokers draw into their lungs and which escapes into the environment between puffs.¹⁰ Some of these materials are listed in Table 3. Note the presence of hydrogen cyanide and methyl isocyanide (the toxicant of the Bhopal disaster).

Cyanide from Fires

An irony of air safety is that planes are built so well today that many passengers and crew members survive the actual impact of a crash but die in the flames that follow. Death often results from breathing the poisonous fumes generated by the burning plastic materials in the interior of the plane. One of the deadly by-products: cyanide.¹ Accidental inhalation of HCN is not uncommon in other accident scenarios. For example, a study showed that cyanide levels in victims of house, automobile and industrial fires are substantial. The key sources of HCN in these cases are cyanopolymer-based materials such as synthetic rubbers (nitrile rubber), fibers, plastics, and adhesives. Among the fibers are the polyacrylonitrile-derived Orlon, Acrilan, and Creslan, which can be found in sweaters, blankets, and carpeting. It has been demonstrated that combustion of one gram of polyacrylic fiber generates approximately 15 mg of HCN.¹¹

Cyanide from Road Salts

Iron cyanide compounds have long been used as additives to road salt as anticaking agents. These compounds can dissolve into snow-melt runoff along with sodium chloride. Although iron cyanide species exhibit low or no toxicity to humans and aquatic life, laboratory studies have demonstrated that they can decompose rapidly on exposure to light, yielding highly toxic free cyanide.¹²

Environmental fate and potential water quality effects of iron cyanide in road salt have been studied little in surface and ground water. Available data and analyses indicate potential negative water quality effects, especially near uncovered salt storage piles. Given the large and increasing heavy use of road salt, environmental fate and effects of iron cyanide in road salts merits further study.^{12,13}

Some Other Facts (or Factoids)

There are claims that, contrary to popular belief, cyanide in minute quantities

and in the proper food forms, instead of being deadly poisonous, actually is an essential component of normal body chemistry. Vitamin B12, for instance, contains cyanide in the form of cyanocobalamin.¹⁴ Montgomery¹⁵ has suggested that trace amounts of cyanide may benefit the body by acting as a brake in cellular oxidative processes.

Then there's the cyanide fraction of Laetrile. Vitamin B17 (also known as Laetrile, amygdalin or nitriloxide), is a cyanide-containing substance that some doctors and scientists have touted as nature's control for cancer. The claim is that this compound releases the cyanide only at the cancer site, thus destroying cancer cells while nourishing non-cancer tissue. Nutritionist June De Spain has compiled three hundred "taste-tested" recipes rich in natural sources of vitamin B17 and published them in her *Little Cyanide Cookbook*.¹⁴ A cautionary note: This cookbook is not recommended for your kitchen library! June De Spain was once hospitalized and almost died from acute cyanide poisoning after eating 25 apricot kernels.^{5,16}

By contrast, Griffin^{17,18} discussed the Hunza, the Himalayan mountain people "world renowned for their amazing longevity" among whom "there never has been a case of cancer." The key to this people's long life, he argued, was their ingestion of large amounts of apricot pits containing vitamin B17. Griffin¹⁷ also claims that "Laetrile is even less toxic than sugar," a fact highly disputed by others.⁵

Rasputin, the "mad monk" in the court of Tsar Nicholas of Russia, was reportedly served chocolate cake laced with potassium cyanide. He ate and

Table 2
Hydrogen Cyanide (HCN) Levels
Liberated from Common Food Crops
Containing Cyanogenic Glucosides²

Food	HCN Yield, mg/100g
Bitter almond	
Seed	290
Young leaves	20
Wild cherry, leaves	90-360
Apricot, seed	60
Peach	
Seed	160
Leaves	125
Sorghum	
Mature seed	0
Etiolated shoot tips	240
Young green leaves	60
Bitter cassava	
Leaves	104
Bark of tuber	84
Inner part of tuber	33
Lima bean, mature seed	
Puerto Rico, small black	400
Puerto Rico, black	300
Java, colored	312
Burma, white	210
Jamaica, speckled white	17
Arizona, colored	17
American, white	10

Table 3
Smokers' Daily Intake
Of Selected Mainstream Smoke Poisons¹⁰

Chemical Substance	Range*
Nicotine	400-3,600
Acrolein	50-370
Carbon Monoxide	50-350
Methyl Isocyanide	6-60
Formaldehyde	9-40
Hydrogen cyanide	8-30
Acrylamide	7-20
Cadmium	3-9
Ammonia	1-5

* Range in multiples of Acceptable Daily Intake. These ranges encompass both the range of cigarette consumption (1-3 packs/day) and the weight range of mainstream smoke constituents.

ate, but to the horror of the poisoners, nothing happened. Schwarcz¹⁹ suggests that one explanation for the botched poisoning is that the schemers used old potassium cyanide that had become inactive by reacting over time with carbon dioxide from the air. He states that under these conditions, potassium cyanide slowly converts to potassium carbonate and releases hydrogen cyanide into the air.

Summary

You don't have to visit or work in a plating shop to be exposed to cyanide. We all are continually exposed to small doses of cyanide, not only in our diets, but in polluted atmosphere and, particularly, cigarette smoke. Cyanide in trace amounts is almost ubiquitous in the plant kingdom and, therefore, present in some of the foods we eat. Unlike chemicals which are deliberately or inadvertently added to foods, elimination of cyanide from foods is not something one can regulate like one can regulate effluent from a plating shop.

A final question. Is your local regulator who specifies that you keep your effluent discharge of cyanide to a few parts per zillion, or zero, aware of all the cyanide that we are exposed to daily? Does this person eat cabbage, lima beans, sweet potatoes, etc? Last, Heaven forbid, is this person a smoker, or exposed to smokers? *PG&SF*

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