Joe Schwarcz: How toxic are the toxins that surround us?

BY JOE SCHWARCZ, SPECIAL TO THE GAZETTE JANUARY 27, 2013

Joe Schwarcz

MONTREAL — We live in a large chemistry lab. A very large one. It's called the universe.

It may not have shelves with neatly labelled bottles, but everything in it is made up of chemicals. Including us. We are nothing but a large bag of chemicals. Thousands and thousands of them. And they are constantly engaged in all sorts of reactions that, taken together, constitute life.

Amino acids link to make proteins, glucose is "burned" to produce energy, DNA instructs cells to make enzymes, neurotransmitters are synthesized, hormones are cranked out, toxins are eliminated and thousands of other processes churn out a stunning array of biochemicals needed for survival.

It stands to reason that, when dealing with such a complex system, sometimes a wrench gets thrown into the works. It may be a photon of ultraviolet light that causes a break in a strand of DNA, a virus that takes over a cell's machinery, a compound that disrupts hormonal function, a bit of pollen that triggers inappropriate immune activity, a bacterium that spews out toxins, a metal ion that impairs nerve cells, or a chemical that causes cells to multiply irregularly.

The more one learns about the goings-on in the body, and about all the things that can go wrong, the more remarkable it becomes that anyone is ever healthy.

While sometimes the wrench that is thrown into the works can be identified, in most cases the specific trigger for a health calamity remains a mystery. Colds can be traced to a virus, an allergy may be pinpointed, and a bout of food poisoning may be linked to a bacterium. But determining what caused the damage to a molecule of DNA that eventually resulted in cancer decades later is another story.

Was it a trace of aflatoxin on a mouldy peanut? Benzopyrene on that charred steak? Acrylamide in the potato chips? Arsenic in rice? Formaldehyde in a cosmetic? Radon seeping into the basement?

Or could it have been the estrogen in the birth-control pill? Aristolochic acid in a dietary supplement? Asbestos in the insulation? Diesel exhaust on the street? Benzene from gasoline fumes? Nitrosamines in hotdogs? Soot from the fireplace? Chloroform in tap water? Naphthalene in mothballs? Phenylenediamine in hair dye? Pesticide residue on an apple?

Or was the cancer triggered by Helicobacter pylori bacteria, or the human papilloma virus?

One could go on and on; there are numerous substances, both natural and synthetic, that can wreak havoc with our biochemistry.

Usually it is synthetic substances that get blamed, despite the fact that, of the 60 million or so known chemicals in existence, only about one-tenth of one per cent are synthetic. Yet these are the ones that get most of the attention, and usually in a negative way.

We hear about “toxic chemicals” and “poisonous chemicals,” usually in reference to pesticides, plastic components, cleaning agents or cosmetic ingredients. Of course, any chemical can be toxic depending on the extent and type of exposure, be it synthetic or natural.

The most potent toxin known is botulin, produced by the Botulinum clostridium bacterium. A few billionths of a gram, way too small to be seen, can be lethal. Ditto ricin found in castor beans. All it takes is an amount equivalent to half a grain of sand.

The fact is we live in a fascinatingly complex chemical world. Smell a cup of coffee and you sniff hundreds of compounds! A whiff in the bathroom will add about 300. A single meal will dump thousands and thousands of chemicals into your body, ranging from the proteins, sugars and fats that plants produce to allow their growth and development, to the pigments and scents they use to attract pollinators.

We are also exposed to a huge array of chemicals produced by industry, such as solvents, dry-cleaning compounds, degreasers, paints, plastic additives, pesticides and packaging materials.

To get a picture of chemical diversity and complexity, consider something as simple as honey. Everyone knows that basically it is composed of sugar and water. But “sugar” is a general term for a variety of simple carbohydrates, the most familiar of which are sucrose, glucose and fructose. But these are not the only sugars found in honey — not by a long shot. There’s a long list of others that includes raffinose, gentiobiose, maltose, maltulose, kojibiose, nigerose, turanose and many more. Then there are proteins, amino acids and various enzymes that include invertase, which converts sucrose to glucose and fructose, and amylase, which breaks starch down into smaller units. There’s also glucose oxidase, which converts glucose to gluconolactone, which in turn yields gluconic acid and hydrogen peroxide. Catalase breaks down the peroxide formed by glucose oxidase to water and oxygen.

Honey also contains trace amounts of the B vitamins riboflavin, niacin, folic acid, pantothenic acid and Vitamin B6. It also has ascorbic acid (Vitamin C) and the minerals calcium, iron, zinc, potassium, phosphorous, magnesium, selenium, chromium and manganese. Then, depending on what plants the bees have been visiting, there are all sorts of flavonoids, of which one, pinocembrin, is unique to honey and bee propolis.

There's still more. Honey contains organic acids such as acetic, butanoic, formic, citric, succinic, lactic, malic and pyroglutamic acids. Use the honey to make cake and you'll be generating dozens of more compounds, including hydroxymethylfurfural, a potential carcinogen!

By now you are asking yourself if there is a point to this onslaught of chemical terms. There is. It has to do with yet another chemical. And that is bisphenol A (BPA), the plastic component that is pilloried on a daily basis. It is said to cause reproductive problems, heart disease, breast and prostate cancer, brain tumours, obesity, thyroid problems, metabolic syndrome, sexual dysfunction, miscarriage, disruption of dopamine activity and impairment of fetal development.

Here is my question: How can this one substance, which chemically resembles so many of the thousands and thousands of compounds to which we are exposed on a regular basis, be responsible for all these horrors?

I suppose it is possible, but I think it is not likely.

I would suggest that there are numerous compounds, both natural and synthetic, which, if studied with as much vigour as BPA has been, would raise similar concerns.

The problem may not be BPA as much as the zeal with which some researchers attempt to convert an association into causation to fit an ideological agenda — while ignoring the fact that none of the more than 6,000 studies of BPA has shown that it causes harm to the average consumer.

As Stephen Hawking said: "The greatest enemy of knowledge is not ignorance, it is the illusion of knowledge."

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