BESTSELLING AUTHOR OF *BRAIN FUEL* AND *AN APPLE A DAY*

DR. JOE'S HEALTH LAB

164 AMAZING INSIGHTS INTO THE SCIENCE OF MEDICINE, NUTRITION AND WELL-BEING

JOE SCHWARCZ, PhD

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INTRODUCTION

I'll be honest with you. I've never been particularly thrilled by lab work. That must sound strange, coming from someone who worships at the altar of science, but it's true. It isn't that I didn't enjoy carrying out research. Discovering something new, whether it has any practical relevance or not, can be very satisfying. But for me, it wasn't satisfying enough. That's because research by its nature tends to be narrowly focused, and I always had a broader interest in science. I realized that if I dedicated myself to laboratory research I would have to concentrate on one area, and I was much too fascinated by the amazing breadth of science to do that. Mine would be a laboratory of the mind, stocked not with flasks, beakers and chemicals, but with the knowledge gained from plowing through work carried out by others. My strength, I thought, lay in interpreting the complexities of scientific research, and in passing the knowledge I gained on to students and the public.

I'm not sure how successful I have been in my endeavours, but I certainly have enjoyed presenting the nuances of science in the classroom, in public lectures, as well as on the radio, television and in my writings. The task is somewhat daunting because it requires keeping up to date with the scientific literature, which these days is virtually unmanageably voluminous. But one does what one can, and I continue to get a kick out of learning new things and passing the knowledge on to others. In the process, I've managed to gather a fair bit of knowledge about nutrition, medications, cosmetics, toxins and household products. But the more you know, the more you realize how much more there is that you don't know.

The word *science* derives from the Latin word for "knowledge." Science begins with the gathering of knowledge through observation and experimentation. The knowledge gained is then organized into testable laws and theories that can be validated through reproducible experiments. To be considered a science, a body of knowledge must stand up to repeated testing by independent observers. That, though, is easier said than done.

We can certainly claim that putting the fizz into a soft drink, neutralizing skunk smell on a dog, producing synthetic vanilla, launching a satellite into orbit, or dissolving rust stains in the toilet bowl are all scientific processes. We understand the exact details of the chemistry or physics involved, and anyone with the required expertise can readily repeat the procedures. In other words, when it comes to answering questions about these matters, we can say with confidence that "we know." But when it comes to matters of health—toxicological issues, in particular—"knowledge" becomes much more elusive.

This shouldn't come as any great surprise, since dealing with the chemical goings-on in the human body is a far more complex business than dealing with rust in a toilet bowl. Furthermore, there are significant differences between people and the rodents that are used in most toxicological studies. Also, matters of health are clearly more

important than matters of rust removal. There is far more at stake. More at stake for researchers forging careers, more at stake for marketers of health products, more at stake for industries accused of producing products with potential toxicity, more at stake for activists trying to raise funds, and of course more at stake for the consumer. It goes without saying that a lot of dollars are at stake as well. Research grants, medical expenses, company profits and even jobs hang in the balance, depending on what is determined to be "known."

But the problem is that what is "known" when it comes to health matters is debatable. Determining whether trace amounts of chemicals in the environment pose a risk to health is not like determining how many calories there are in a gram of sugar. And when there are various vested interests involved, there is always the motivation to twist data in the direction of a desired outcome. It is not uncommon for academic or industrial researchers to be accused of such data manipulation, but somehow environmental groups, at least in the public eye, are often judged to be above such antics. The truth is that all stakeholders strive to present their viewpoint in the most convincing fashion. Allegations about research tainted by vested interests are often met with accusations of irrational fearmongering, leaving the public bewildered.

Adding to the confusion is the incredible blast of information directed at us constantly by the media. Virtually every day seems to bring "breakthrough" research that either warns us about a chemical that may hasten our demise, or comforts us with the prospect of some miraculous drug or dietary supplement that will allow us to live longer and healthier lives.

And then there is the Internet. Clearly, a wonderful source of reliable information if one knows where to look, but websites promoting nonsensical views or products are often more seductive than those based on rational science. Charlatans and assorted kooks trap the unwary in a web of deceit. Understandably, people want to

know what's what, who is to be trusted. What they don't understand is how hard it is to really "know," especially when it comes to questions about the likes of endocrine disruptors, genetically modified foods, herbal remedies, electromagnetic fields, dental fillings or pesticide residues.

On the other hand, there is much that we do know. Interesting stuff. We know about probiotics, beta-blockers, the effects of bicycle seats on erectile dysfunction and how to make trans fat–free margarine. We know what happens when you ingest meow-meow, why Asians are more likely to flush red after drinking alcohol and why oolichan may have some health benefits. We also know what glucosamine can and cannot do, why an apple a day may keep the oncologist away, why you may want to consume beta-glucan, why Hippocrates thought that watercress was particularly healthy and why you may want to steer away from an Electro-Physio-Feedback-Xrroid device or a Danish water revitalizer. We even know about toilet bowl cleaner—and why you should never mix it with bleach. If you want to know too, just turn the page and step into my lab. No lab coat or safety glasses required.

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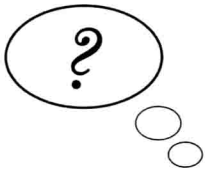

HEALTH AND SUPPLEMENTS

Why would you want to consume beta-glucan?

The traditional answer is to lower your cholesterol. But there is accumulating evidence that this form of soluble fibre—found, for example, in oat bran—can perk up our immune system. Fibre is the indigestible part of the oat grain, meaning that it isn't broken down into components that can be absorbed into the bloodstream. So if it isn't absorbed, how can it have an effect on blood cholesterol? As beta-glucan travels through the digestive system, it binds bile acids—compounds synthesized in the liver and then secreted into the small intestine to aid in the processing of dietary fats. These bile acids are usually reabsorbed and recycled. But when they are bound by beta-glucan, they end up being eliminated from the body and therefore have to be replaced. This means that the liver has to make fresh bile acids, and since the raw material for this synthesis is cholesterol, the result is that blood cholesterol levels drop.

There's a second mechanism that operates as well. Bacteria that live in the large colon recognize beta-glucan as a tasty morsel. As they dine on it, they excrete compounds called short chain fatty acids that are absorbed into the bloodstream. Short chain fatty acids

can impair cholesterol synthesis, so the liver has to use existing cholesterol to make bile acids. The problem, though, is that it takes a fair bit, about five to six grams, to trigger a significant lowering of cholesterol levels. That translates to a lot of oat bran—about three servings, quite a challenge. But beta-glucan is also available as a dietary supplement, and interestingly may serve a purpose beyond just lowering cholesterol, even at a reduced intake.

Over the last thirty or so years, beta-glucan has received a lot of attention from researchers because of its purported ability to activate the immune system. Certain immune cells recognize invaders such as yeasts, fungi and bacteria by the polysaccharides they harbour on their surface. When the immune cells sense these compounds, they are activated to attack the intruders. Beta-glucan is a polysaccharide composed of glucose units linked together in a chain similar to that found in microbes. When immune cells encounter beta-glucan in the bloodstream, they are tricked into greater activity, mistaking beta-glucan for microbial polysaccharides. These activated cells then go and seek out invaders that they otherwise may not have found.

Macrophages, for example, are white blood cells that destroy invaders by engulfing them and pummelling them with chemicals that break them down. But first they have to be activated. Beta-glucan can do this by binding to their surface and stimulating the production of free radicals. These in turn signal the immune cells to engulf and destroy intruders such as bacteria, viruses and even tumour cells. Studies have shown that beta-glucan can reduce postoperative infections after high-risk surgery, and studies in mice have shown that animals treated with beta-glucan have a higher survival rate when injected with aggressive tumour cells.

In Japan, a beta-glucan preparation known as Lentinan, isolated from the shiitake mushroom, is used as an intravenous adjuvant to chemotherapy. Shiitake mushrooms themselves have a long folkloric history of use against infections of all types, including

the common cold. Experiments have shown that shiitake promotes the production of interleukin, a hormone that stimulates the immune system to produce B-cells that create antibodies as well as helper T-cells that coordinate the immune response. So far, though, evidence of any sort of practical immune boost by taking oral supplements of beta-glucan is pretty thin, and the European Food Safety Authority has recently turned down an application by a German beta-glucan producer for a label claim of "improving the body's immune system against the common cold" because of insufficient evidence. The jury on beta-glucan supplements is still out, but in the meantime, do keep eating your oat bran for breakfast.

When a drop of iodine solution is placed on a vitamin C tablet, the deep brown colour quickly fades. What does this demonstrate?

That vitamin C is an antioxidant. Vitamin C (ascorbic acid) reduces elemental iodine (I_2) to iodide (I^-) by providing electrons. In chemical terms, this is called a reduction. Reduction is the opposite of oxidation, hence the expression *antioxidant* to describe the action of vitamin C. In practical terms, this means that vitamin C has the ability to donate electrons to free radicals and neutralize their effect. Free radicals have been linked with various disease processes.

What common feature characterizes the fruit-eating bat, the guinea pig and the red-vented bulbul?

These three animals (the bulbul is a bird), like man, require a source of vitamin C in their diet. Most animals can biosynthesize vitamin C and can live happily without its presence in the diet. Primates, of course, cannot make it and must have a dietary supply. The main role of vitamin C is to prevent scurvy, but we do not need very much to do this. About 10 milligrams a day is sufficient. But a higher intake of vitamin C is appropriate because of its anti-oxidant effect.

What dietary supplement, claimed to treat the pain of osteoarthritis, is derived from the shells of shrimp or crabs?

Glucosamine is a popular over-the-counter treatment for osteoarthritis, a painful condition associated with the deterioration of cartilage, the flexible connective tissue that cushions the joints between bones. When cartilage wears away, bone painfully rubs on bone. The idea of using glucosamine to treat osteoarthritis stems from the observation that glucosamine formed naturally in the body is the precursor for the biosynthesis of glycosaminoglycans, major components of cartilage. Perhaps supplementing the body's supply of glucosamine would help repair cartilage, the thinking went.

But thinking, even if scientifically rational, is not evidence. And this is where we run into difficulties with glucosamine. While some early studies showed a benefit, more recent, larger and better controlled trials have failed to live up to the original optimism. Glucosamine

comes in two possible forms, the sulphate or the hydrochloride. The hydrochloride actually yields more glucosamine in the body, but practically speaking, the difference is not much. Low-back pain can often be caused by osteoarthritis, and glucosamine supplements are widely promoted for this condition.

A placebo-controlled study using 1,500 milligrams of glucosamine sulphate showed no difference between the experimental and the placebo groups, but both groups did show some improvement. Results seem to be somewhat better when glucosamine is combined with chondroitin, a substance isolated from pig or cow cartilage. It is thought to improve the elasticity of cartilage and to inhibit enzymes that break it down. This combination helps to ease moderate to severe knee pain in osteoarthritis patients, but is not useful for mild pain.

Glucosamine is relatively easy to isolate and purify so that the amounts declared on a label tend to be close to correct, but chondroitin is another story. Purification of this substance is more difficult, and some supplements contain much less than the amount listed on the label. The usual dosing directions are 750 milligrams of glucosamine and 600 milligrams of chondroitin to be taken twice a day. An effect, if there is to be one, may take several weeks to kick in. If there is no observable improvement after three months, there won't be any. Glucosamine is safe enough, but is not totally risk free. Some products have been found to exceed the daily limit of 0.5 micrograms of lead.

Researchers at Laval University found that glucosamine, albeit at significantly higher doses than recommended for humans, caused pancreatic cell death in the laboratory. The implication of this for people is not clear, but the study does suggest that recommended doses should not be exceeded. That warning has relevance because many osteoarthritis patients increase their dosage beyond recommended levels when they do not experience the expected results. Since osteoarthritis treatments leave a lot to be desired, patients

can't be blamed for giving a combo of glucosamine and chondroitin a shot. At the very least, they have a good chance at experiencing a placebo effect.

"Theriacs" were a staple in pharmacology for close to two thousand years. What were they?

Theriacs were potions that were believed to prevent and cure disease. Their history can be traced back to Mithridates VI, who ruled the ancient Asian kingdom of Pontus in the first century BC. The king was terrified of being poisoned—not an unreasonable worry, given that assassins at the time were adept at using plant and animal toxins to dispatch enemies. But Mithridates was determined not to be done in by poison hemlock, henbane, snake venom or any other such poison. He had an idea: Why not try to protect himself by taking small amounts of poisons to develop a tolerance to larger doses? Today we know that it is possible to develop immunity to substances; after all, that's how allergy shots work.

Just where Mithridates, with no knowledge of immunology or toxicology, got such an idea is mired in mystery. Some accounts claim the king had observed that ducks in his realm suffered no harm even though they ate poisonous plants. He concluded that their blood must have some protective substance, so blood from Pontic ducks naturally became one of the ingredients in "mithridatum," to be joined by some thirty-four plant extracts, beaver gland secretions and honey.

How effective was this concoction? According to the legend, very. When Mithridates was defeated by the Roman general Pompey, he tried to commit suicide by taking poison. It didn't